UNIVERSITY OF CALIFORNIA, RIVERSIDE

Multidisciplinary Research Building 1

Project No. 950528

Specifications

Division 01 – General Requirements

Issue for Construction

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SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Work covered by the Proposal Documents.
2. Type of the Contract.
3. Work phases.
4. Work under other contracts.
5. Products ordered in advance.
6. University-furnished products.
7. Use of premises.
8. University's occupancy requirements.
9. Work restrictions.
10. Specification formats and conventions.

B. Related Sections include the following:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of University's facilities.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Multidisciplinary Research Building 1, Project No, 950528.

1. Project Location: University of California, Riverside, Aberdeen Drive & North Campus Drive.

B. Owner: Regents of the University of California

1. Owner's Representative:
   a. University of California, Riverside, Architects and Engineers Offices.
   b. Jacqueline Norman, Architect, Senior Project Manager
      jacqueline.norman@ucr.edu, phone#: 951.827.6316

C. The Work consists of the following:

1. The University of California, Riverside (UCR) intends to procure the services of a Design-builder to design and construct the Multidisciplinary Research Building 1 (MRB1). The project consists of approximately 143,000 gross square feet (GSF) and approximately 87,000 assignable square feet (ASF) of new construction. MRB1 will provide wet and dry research laboratories, core laboratory support facilities, a vivarium, and space for faculty and academic support. The project is envisioned to host multiple scientific disciplines engaged in collaborative research at the intersection of biosciences, medicine, and engineering. Provisions for utilities and landscaping are part of the Project.

1.3 TYPE OF CONTRACT

A. Project will be designed and constructed under a single prime contract.

1.4 WORK PHASES

A. The Work shall be conducted in three (3) phases in the following order, with each phase substantially complete before beginning the next phase unless otherwise directed by the University's Representative:

1. Phase One: This phase consists of the preparation of Schematic and Design Development level drawings and specifications based upon the bridging document design submitted as part of the Design Builder's Proposal for the project along with any alternates submitted with the Proposal which have been accepted by the University. The Contract Time for this phase is identified in the Contract. The Contract Time periods for this phase shall commence on the date identified in the Notice to Proceed.
2. Phase Two: This phase consists of the preparation of Construction Documents, drawings and specifications, based upon the documents approved in Phase One of the Project. The Contract Time for this phase will commence upon the completion of Phase One.
3. Phase Three: This phase consists of the Construction of the Project based upon the documents approved in Phase Two of the Project. The Work Contract Time for this phase is identified in the Contract. The Contract Time period for this phase shall commence on the date identified in the Contract Documents.

B. Before commencing Work of each phase, submit a schedule showing the sequence, commencement and completion dates, and move-out and -in dates of University's personnel for all phases of the Work.

1.5 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.6 USE OF SITE

A. General: Design Builder shall have full use of construction site for operations as indicated by the Contract limits. Design Builder use of premises is limited only by University's right to perform work or to retain other contractors on portions of Project. Design Builder shall have limited use for construction operations outside of the Contract limits.

B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb adjacent portions of Project site beyond areas in which the Work is indicated. Areas within project fence limits that are not scheduled for improvements are to be restored to their original condition at final completion.

1. Limits: Confine constructions operations to:

a. Work area: Areas where the new construction is located.
b. Lay-down area: Areas for use in access, storage, and other typical activities. Lay-down areas are to be restored to their original condition at final completion.

2. University Occupancy: Allow for University occupancy of Project site.
3. Driveways and Entrances: Keep fire lanes, driveways, parking garage, loading areas, and entrances serving other facilities clear and available to University's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

4. Parking:

a. General parking for construction forces shall be coordinated with Design Builder, UCR TAPS (Transportation and Parking Services) and University Representative. Monthly parking passes are available for purchase at:
1) 683 Linden Street
Riverside, CA 92521
b. Limited parking may be allowed adjacent to Contractors on site office facilities as well as designated temporary construction lay-down area (parking lot 25).
c. Comply with the University's parking regulations.

C. Use of Site for Dwelling: The Site may not be used for residential purposes under any conditions. Do not provide or allow on-site facilities that could be used for habitation.

1.7 UNIVERSITY'S OCCUPANCY REQUIREMENTS

A. Full University Occupancy: University will occupy existing adjacent building(s) during entire construction period. Cooperate with University during construction operations to minimize conflicts and facilitate University usage. Perform the Work so as not to interfere with University's day-to-day operations. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used adjacent facilities without written permission from University's Representative.
2. Provide not less than 14 days notice to University's Representative of activities that will affect University's operations.

B. University Occupancy of Completed Areas of Construction: University reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion of all portions of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. University will prepare a Certificate of Beneficial Occupancy for each specific portion of the Work to be occupied before completion of the project. Comply with requirements in Division 01 Section, "Closeout Procedures" for partial occupancy.
2. Obtain a Beneficial Occupancy before University occupancy.
3. Before partial University occupancy, mechanical and electrical systems shall be operational, and required tests and inspections shall be successfully completed. On occupancy, University will operate and maintain mechanical and electrical systems serving occupied portions of building.
4. On occupancy, University will assume responsibility for maintenance and custodial service for occupied portions of building.

1.8 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed during extended working hours of 7:00 a.m. to 9:00 p.m., Monday through Friday, Saturdays (when necessary) 8:00 a.m. to 6:00 p.m., except as otherwise indicated. Requests for exceptions must be submitted to the University two days before the Work is to commence:

1. No Sunday work.
2. Weekend Hours: to be approved in advance by the University's Representative.
3. Early Morning Hours: if the University determines that it is unlikely to affect adjacent campus activities and personnel.
4. Hours for Utility Shutdowns: shall be during off hours or weekends unless otherwise approved by the University's Representative.

B. Noise: Prior to initiating on-site construction, University Representative shall approve Design Builder specifications that include measures to reduce construction/demolition noise to the maximum extent feasible. These measures shall include, but are not limited to, the following:

1. Noise-generating construction activities occurring Monday through Friday shall be limited to the hours of 7:00 am to 7:00 pm, except during summer, winter, or spring break at which construction may occur at the times approved by University Representative.
2. Noise-generating construction activities occurring on weekends in the vicinity of (can be heard from) off-campus land uses shall be limited to the hours of 9:00 am to 6:00 pm on Saturdays, with no construction occurring on Sundays or holidays.
3. Noise-generating construction activities occurring on weekends in the vicinity of (can be heard from) on-campus residential housing shall be limited to the hours of 9:00 am to 6:00 pm on Saturdays, with no construction on Sundays or holidays. However, as determined by University Representative, if on-campus residential housing is unoccupied (during summer, winter, or spring break, for example), or would otherwise be unaffected by construction noise, construction may occur at any time.
4. Construction equipment shall be properly outfitted and maintained with manufacturer recommended noise-reduction devices to minimize construction-generated noise.
5. Stationary construction noise sources such as generators, pumps or compressors shall be located at least 100 feet from noise-sensitive land uses (i.e., campus

housing, classrooms, libraries, and clinical facilities), as feasible, or as approved by University Representative.

6. Laydown and construction vehicle staging areas shall be located at least 100 feet from noise-sensitive land uses (i.e., campus housing, classrooms, libraries, and clinical facilities), as feasible, or as approved by University Representative.
7. All neighboring land uses that would be subject to construction noise shall be informed at least two weeks prior to the start of each construction project, except in an emergency situation. Provide sufficient notice to University Representative to allow notice to be issued by the University or work shall not be allowed.
8. Loud construction activity such as jackhammering, concrete sawing, asphalt removal, core drilling, pile driving, and large-scale grading operations occurring within 600 feet of a residence or an academic building shall not be scheduled during any finals week of classes. A finals schedule is available on the University's website.

C. University Holidays: The following is a list of University holidays. No Work requiring inspection should be scheduled on these dates. Design Builder shall verify with the University's Representative the specific dates of each University holiday for each year.

1. New Year's Day
2. Martin Luther King Day
3. Presidents' Day
4. Cesar Chavez Day
5. Memorial Day
6. Independence Day
7. Labor Day
8. Veteran's Day
9. Thanksgiving Day (and day following)
10. Christmas Eve Day
11. Christmas Day
12. New Year's Eve Day

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify University not less than thirty days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without University's Representative written permission. Under no circumstances shall the contractor shutdown utility systems.
3. Utility outages involving reclaimed water, potable water, high temperature water, chilled water, compressed air, natural gas, and 12 kV electricity shall be conducted by or under the supervision of the University's Facilities Management.

E. Nonsmoking Building: UCR is a non-smoking campus.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and 2014 CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
3. Refer to General Conditions, Article 1, paragraph 1.3.4 for additional requirements.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Refer to General Conditions, Article 1, paragraph 1.3.5.
2. Refer to General Conditions, Article 1, paragraphs 1.3.6 and 1.3.7 for additional requirements.
3. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Design Builder. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Design Builder or by others when so noted.

a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.10 MISCELLANEOUS PROVISIONS

A. Archaeological Artifacts: The University requires that all excavation and related construction activities be suspended immediately on discovery of archaeological artifacts on any construction site until the University's Representative authorizes continuation of construction activities.

1. Archaeological artifacts include, but are not limited to, pottery shards, bone fragments, spear points, and arrowheads.
2. If archaeological artifacts are found during excavation operations, stop all excavation activities immediately. Notify the University's Representative to arrange for a site inspection. Take precautions to protect artifacts in place. Do not remove or disturb artifacts unless authorized to do so by the University's Representative.
3. A qualified paleontologist shall be retained by the University to perform periodic project-specific inspections of the excavations and to salvage exposed fossils. The paleontologist shall be allowed to divert or direct grading in the area of an exposed fossil in order to facilitate evaluation and, if necessary, salvage the

exposed fossil. Due to the small nature of the fossils present, fine mesh screens shall be used at the discretion of the paleontologist at project-specific inspections to collect matrix samples for processing. Provisions for preparation and identification of any fossils collected shall be made before donation to a suitable repository. All fossils collected shall be donated to an institution with a research interest in the materials.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 01 1300 - BIM SPECIFICATIONS

PART 1 – GENERAL

1.1 SUMMARY

A. Design-builder: The Design-builder will employ VDC and BIM tools to facilitate the construction, coordination, scheduling, phasing, and close out of the Work. The VDC and BIM requirements will be developed and refined with UCR via BIM Execution Plan (BXP), the final BXP shall be formally submitted to UCR for review and approval. The BIM Process shall be an integral part of project delivery and shall be used for:

1. Enabling all stakeholders to view and track the project throughout design, construction and closeout.

2. Enabling a coordinated Design Build delivery of Construction Documents and Shop Drawings. The Design-builder, its Design Professionals and Consultants, its Subcontractors and their Subcontractors shall assist, integrate and use the BIM model for the creation of construction documents and shop drawings.

3. Enabling ~~cost and~~ schedule project tracking via 4D Milestone ~~and 5D~~ BIM model information. ~~5D BIM model information will not be required through 30% submittal.~~ Milestones shall include the following:

   a. Placement of foundation concrete
   b. Placement of slab on grade concrete
   c. Placement of slab on deck concrete (all levels)
   d. Placement of vertical concrete (all levels)
   e. Start of exterior skin installation
   f. Completion of exterior skin installation

B. BIM Manager: The Design-builder shall appoint a BIM manager to develop and oversee the BIM Execution Plan (BXP) as defined in Section D of this PR. His/her detailed responsibilities will include overseeing the development of the model, its integration and execution, and coordinate between all entities of the Design Build Delivery. The Design-builder's BIM manager will coordinate with UCR's BIM manager concerning setting up the appropriate templates and project boundaries.

1.2 DEFINITIONS

A. As-Built Construction Model (aka Record Model; aka Record As-Built Model): A Construction Model modified to reflect as-built conditions of the work as constructed during construction phase, including fabrication and coordination modeling.

B. BIM: Building Information Modeling, a process of developing electronic 3D virtual representation of the Project's buildings, structures, infrastructure, and site improvements, utilizing modeling software that is fully object-based, parametric, database system.

C. Construction Detailing Activity (CDA): CDA is an on-site coordination program to confirm

aspects of the Project's design and installation in an orderly and systematic way prior to fabrication and installation. The basis of the CDA is to assure that all utilities, architectural and structural building systems are inter-coordinated and agreed upon by University, Design Builder and subcontractors.

D. Construction Model: A discipline-specific Model that contains the equivalent of shop drawings and other information useful for construction. Construction Models typically are prepared by subcontractors and include, but are not limited to, structural steel, mechanical systems, electrical systems, plumbing systems, fire protection systems, and other specialty shop drawing Models.

E. Design Model: A discipline-specific Model prepared by a Design Professional to illustrate the design intent of the architectural, structural, mechanical, electrical and plumbing (MEP) design requirements of the Project.

F. Federated Model (Fed Model): The Fed Model that combines all linked, Native Models and is a virtual representation of the entire Project developed to a specified Level of Development. The Fed Model shall consist of discipline Native Models including Civil, Architectural, Structural, Mechanical, Plumbing, Electrical, Fire Protection and Special Equipment.

G. Level of Development (LOD): The term used to describe the fullness and definitiveness of the Model; each Model can have a varying LOD depending on the phase of the Project life-cycle, and agreed utilization of the Model.

H. Linked Model: A Native Model linked to the Federated Model.

I. Model: The broadest term used to describe the 3D virtual representation of a Project and its Objects. The Model is generally, an assemblage of several Models produced by various disciplines, each of which is comprised of numerous Objects.

J. Native Model: The Model and its imbedded Objects created by a specific, responsible discipline such as architect, structural engineer, or specialty contractor, etc.

K. Object: The term used to describe the 3D virtual representation of each of the separate sub-parts of a Model such as doors, walls, equipment, etc. If an Object is, in itself, comprised of several sub-elements, the sub-elements shall be grouped into one virtual representation of that Object. Example: a panel board might be comprised of top, sides, back and front sub-elements; if so, then those sub-elements shall be grouped into one selectable and identifiable Object.

L. Reconciled Design Model (RDM): A separate, discipline-specific Design Model that accurately reflects clarifications and changes made during Project construction.

1.3 A COORDINATION AND DETAILING ACTIVITY (CDA)

A. The Design-builder's Coordination and Detailing Activity (CDA) shall include a formal process to document, track and confirm the coordination and detailing process of the design and construction teams. CDA ensures agreement among Subcontractors regarding field coordination aspects of the Projects. CDA and BIM coordination are complementary processes to the review of construction drawings for their completeness, constructability, and code compliance.

B. Conflicts shall be resolved through the CDA process rather than at the installation stage. Conflicts occurring at the installation stage will not be the basis for additional costs or time extensions. Failure to perform the CDA process satisfactorily will not be the basis for additional compensation or extension of the Contract Time.

C. CDA is performed to assure that all utilities, architectural and structural building systems are inter-coordinated and agreed upon by Design-builder, its design professionals and Subcontractors, minimizing field changes. CDA is to be utilized as a validation mechanism to the BIM coordination process and clash / collision detection and resolution. The end product of this effort shall be a fully coordinated model ~~and set of drawings~~, consistent with the design intent and Applicable Code Requirements for the Work. Upon the completion of the CDA process, Design-builder, its Design Professional and Subcontractors shall indicate in writing that they have coordinated their Work prior to starting construction.

D. CDA shall occur ~~at a minimum on a weekly basis~~ as needed to maintain the CDA schedule as soon as the first Subcontractors are engaged on the project, and concurrently with development of the Construction Drawings. CDA milestone submittals shall be ~~required with the 60%, 90%, and 100% progress submittals~~ submitted once the 65% DP-4 package has been submitted for UCR review.

E. The provisions of this Section shall not reduce the Design-builder's responsibility to provide adequate coordination for all Work including Work not indicated above.

F. UCR, the Design-builder's Project staff, Subcontractors, and Design Professionals shall participate in this program. At the completion of the CDA, the Design-builder, its design professionals and Subcontractors are required to sign off on their acceptance. Signatures shall indicate that the Work represented on the CDA drawings is constructible and has been reviewed by Design-builder, Design-builder's Design Professionals, and Subcontractors and all are in concurrence with information contained on the CDA Drawings.

G. CDA drawings shall be ~~2d or axonometric print outs of the BIM models and shall be~~ usable as field documents aimed at coordination and allocation of work between different trades (structure, framing, casework, ceilings, ductwork, plumbing and mechanical piping, electrical and LV conduits and outlets, MEP and architecturally or structurally significant equipment, miscellaneous anchorage, supports and bracing of different trades, exterior wall components, code clearances, etc.).

H. Exterior Wall Coordination: Separate Overlay Drawings for Coordination of ~~All Miscellaneous Steel and/or~~ Structural Stud Systems on Background Drawings and Elevations: Illustrate the ~~connection points of the precast, windows, curtain wall, stone, metal panel systems, as well as all elements that will be contained in the exterior wall systems including but not limited to~~ recessed electrical, communications outlets, security devices, panels, telephones, recessed water connections, lighting and alarms, the Design-builder's Design Build team shall prepare an overlay CDA drawing for all recessed systems.

I. CDA Drawings: The Design-builder shall prepare CDA Drawings to optimize the utilization of space, provide for efficient installation of different components, and coordinate the installation of products and materials. The CDA drawings shall be the basis for coordinated shop drawings. Additional shop drawings shall not be produced after signing off CDA drawings without review, verification, and sign-off by all trades that changes did not impact agreed-upon coordination. There are other potential areas of the building systems that will require a process for completion. These should be illustrated in the Design-builder's work plan and schedule.

J. Orientation Meeting: The Design-builder, its Design Professionals, Consultants, Subcontractors, and UCR shall hold an orientation meeting prior to the beginning of the CDA effort. The purpose of this meeting is to develop a mutual understanding of the administration of the CDA, and the scope of the required submittals and Drawings. All personnel involved in coordination and detailing of the work and the BIM model of shall attend the Orientation Meeting. The meeting shall be administered by the Design-builder's BIM manager and the Design-builder's MEP / Systems Coordinator.

K. CDA Meetings: During CDA meetings the Design-builder, its design professionals and its Subcontractors shall discuss and coordinate the locations of utilities and building elements, problems of fit, trade interfaces, and constructability. ~~As a minimum,~~ CDA meetings will be held as often as necessary to maintain the CDA schedule ~~biweekly prior to the CDA finish milestone~~. UCR may attend all CDA meetings. The Design- builder shall prepare and distribute meeting minutes to document session resolution decisions or track issues requiring further rework of the drawings and re-coordination.

L. Conflict Resolution Plan: Design-builder must provide leadership in the space allocation, and adjusting of previous designs in order to resolve BIM conflicts in an effective and timely manner while maintaining design quality, and maintenance space allocation. Specialty Subcontractors shall work with the Design-builder's MEP Coordinator to identify alternate acceptable routes to resolve conflicts. The Design-builder shall be present to provide leadership and assign responsibilities as required to find alternate routing methods for conflict resolution. Resolve Conflicts and Re-detail or re-model as required. Generate a conflict list that shall identify all systems that are in conflict with another building system. Revise discipline models as required to avoid a particular building systems that cannot be relocated. Revise the discipline models with the intent of eliminating the interference's and conflicts.

1.4 BUILDING INFORMATION MODEL (BIM):

A. Design-builder's BIM MODEL shall include at a minimum the following:

1. Development and maintenance of a three-dimensional building information model of the Work that includes Design-builder - developed, shop-drawing level information of the following building components and systems:

a. Underground, including but not limited to, utilities: piping, connections, vaults, manholes, tanks, valves, vents, and structural: shoring, shafts, tunnels, and impact zones.

b. Building structure, including but not limited to foundations, columns, beams, joists, purlins, floor and roof decking and fill, bracing, and load-bearing walls.

c. HVAC systems, including but not limited to HVAC piping and pumps, air distribution ductwork, fans, air terminal units, tanks, ~~grease, interceptors,~~ air outlets and inlets; central cooling equipment compressors, chillers, condensers, and cooling towers; boilers, heat exchangers and packaged and/or custom air-handling units, tanks, ~~grease interceptors,~~ and thermal storage systems and supplementary structural support members, hangers, and seismic support.

d. Plumbing systems, including but not limited to water distribution, storm drainage and sanitary sewerage waste and vent piping, water-heaters and plumbing fixtures systems and supplementary structural support members, hangers, and seismic support.

e. Fire suppression systems, including but not limited to, standpipes, sprinkler systems, fire pumps, and non-water-based fire-extinguishing systems and supplementary structural support members, hangers, and seismic support.

f. Electrical systems, including but not limited to conduit 1-1/2 inches in diameter and larger, or bundled conduits, cable-tray, transformers, switchgear, panel boards, generators, lightning protection and lighting and supplementary structural support members, hangers, and seismic support.

g. "No fly zones" will be established to dedicate general areas for the installation of ~~C~~communication, security, access control, alarm monitoring (ACAMS), and wireless systems, including but not limited to, structured cabling, premise wiring distribution system, equipment room fittings, racks, frames and enclosures, data communications switches, hubs, and routers, common use systems, and paging systems and supplementary structural support members, hangers, and seismic support. Individual wires will not be included in the Construction Models.

~~h. Conveying systems including elevators, escalators, and moving walks and equipment control cabinets, passenger boarding bridges and ramp service equipment.~~

~~i. Baggage handling systems including indication of clear right-of-way required around conveyors and catwalks, access ramps, no-fly access zones, supplementary structural support, and equipment Control cabinets.~~

j. Architectural building systems including interior and exterior walls, windows, curtain walls, ceilings, and roof.

k. Coordination and Detailing Activity (CDA) and Collision Detection: Based on information developed and included in the Design-builder's three dimensional BIM model, perform ~~weekly~~ collision/interference checking and develop reports for review and resolution by the integrated Design-builder team, including the design team, Subcontractors, manufacturers and suppliers, prior to release of fabrication drawings. Ensure all drawings and backgrounds are coordinating at all levels of detail necessary for fabrication and field installation. Refer to the Coordination and Detailing Activity section in this PR for requirements.

l. Schedule ~~and Cost~~ Visualization (4D ~~and 5D~~): Develop, update and maintain Schedule ~~and Cost~~ tracking information and all meta data required by UCR and described in this PR. Develop and maintain 4D ~~and 5D~~ BIM information with the expressed purpose of visually demonstrating and communicating proposed project construction schedule, and phasing~~, and cost tracking~~ to UCR and its consultants, the Design-builder's design team, and Subcontractors and their Subcontractors and suppliers as applicable. The model shall include all major ~~building systems and shall be constructed in such a fashion as to permit animation showing sequential construction of the project based on and driven by the approved construction schedule~~ milestones as noted in Section 1.1 of this specification.

m. Architectural Visualization: Develop three dimensional renderings using the BIM model and enhance with rendering programs to clearly illustrate the architectural (aesthetic) design, as described in the Project Requirement – Scope of Work.

n. Use of BIM for Facility Management and Maintenance: Upon completion and commissioning of the Project, UCR's goal is to use the Design-builder's Record Model prepared in BIM software for integration into its Building Management and Maintenance. During the preparation of Construction Documents, the Design-builder shall meet with UCR's operations and maintenance staff and discuss specific requirements that shall be built into the BIM model. It is the intent that any implementation of additions to the BIM design model for Building Monitoring Management and Maintenance will be included as part of future task authorizations. Refer to Project Requirement for Project Closeout.

1.5 BIM EXECUTION PLAN (BXP):

A. The Design-builder shall prepare a BIM Execution Plan (BXP) to include master information/data management and assignment of roles and responsibilities for model creation and data integration at project startup. The BXP shall be submitted no later than 30 days after the first NTP and shall address use of multiple software products, training of staff, collaboration and sharing of information models on a common review software platform for open communication and effectiveness of clash detection, and graphic presentations of multi-discipline integrated design. The plan shall highlight responsible individuals designated to manage discipline coordination, and attend regular Design/Build Team coordination meetings. The plan should include, or address the following:

1. List of specialty Subcontractors using digital fabrication.

2. Proposed BIM Software to be used by the Design/Build Team and fabrication modelers.

3. ~~Proposed specialty Subcontractor BIM workshops and training integrated into project schedule.~~

4. Proposed uses of digital fabrication.

5. Strategy to assure all trade information is modeled and coordinated.

6. Discipline coordination strategy for clash detection via the CDA process.

7. Development strategy from Design to Construction Model.

8. Constructability analysis with BIM.

9. ~~Development of graphics showing installation methods for building equipment and systems.~~

10. Space allocation showing space clearance reservations for operations, repair, maintenance, and replacement.

11. Strategy for software compatibility, file formats, hosting, transfer, and access of data between disciplines.

12. Use of model server, extranet, access security, etc.

13. Use of Milestone 4D scheduling and construction sequencing technology, including submission and monthly update process.

14. ~~Use of 5D cost loading technology, including submission and monthly update process.~~

15. Use and training of Commissioning and facilities management related technology.

16. List of final BIM deliverable for each respective discipline.

17. Updating as-built conditions in As-built/Record BIM.

B. Model Management during Construction: The BXP shall describe the process of developing the Record As-built Model from continuous updates of the Construction Model. All as-built

information shall be reconciled and included in the record model. The Design-builder shall continuously update the BIM model ~~to~~ in 3D format and will include RFI's, Change Orders, ~~Submittals~~, and all other changes affecting the project's design and construction. 2D changes will be documented in the as-built set of the contract documents. The Design-builder shall demonstrate continuous updating of the model and submit status on a monthly basis. An updated model is a payment requirement as stated in the Special Conditions.

C. As-built Construction Model Creation and Delivery: The BIM model, as it is updated throughout the project duration, shall represent in electronic format the physical design and construction of the project throughout all trades. The Design-builder shall provide the Record as-built model as required in the Project Requirements for Project Closeout.

1.6 BIM MODELING REQUIREMENTS

A. Summary: The Design-builder shall develop and submit for approval a Federated Model (Fed Model) of the Project utilizing a Building Information Modeling (BIM) system as defined by this Section. The Design-builder shall:

1. Manage communication and coordination between the Design-builder's design professionals and Subcontractors to develop the Fed Model throughout the Work of the Project.

2. Submit a LOD 300 Fed Model to UCR for review and approval ~~as part of the 60% Drawings submission~~ after the sign off of each level (i.e. site utilities, underground, Lower Level, Level 1, etc.).

3. Use the Fed Model to facilitate the construction methods and means.

4. Update the Fed Model progressively throughout the construction period to incorporate all construction actions so that the Fed Model shall be developed to LOD ~~400~~ 350 construction level, including:

   a. Shop Drawings
   b. Approved Change Orders
   c. Fabrication, assembly and detailing
   d. Field Modifications
   e. Submit the Model to UCR for review and approval at 90% and 100% completion of the Work of the Project.

5. Provide a final "as-built" LOD 500 Fed Model to UCR as part of the Project Close-Out phase.

~~6. Definitions: (Refer to General Conditions for definitions)~~

1.7 USE OF FEDERATED MODEL AND AS-BUILT MODEL (Reconciled Design Model RDM)

A. The Design-builder shall prepare and maintain the Federated Model and the Design Model throughout the duration of the project. At the completion of the Work these models shall be turned over to UCR. The university shall have exclusive rights to the models for their use: 1) as an as-built model for future modification to the constructed facilities and 2) as a source of data for large equipment in operating and maintaining the facility. The Reconciled Design Model (s) (RMD), prepared by licensed design professionals, shall have the legal bearing of the Design Intent.

B. Basis of Information for Modeling: The Construction Documents (drawings and specifications) shall be the basis of information for the Fed Model described herein. If any or all of the university's own models are available for use by the Design-builder in developing the Fed Model, such usage shall be for convenience only and shall not carry contractual implication.

C. Relation of BIM to other Contract Documents: If the Design-builder through developing and/or use of the BIM or Fed Model identifies any potential changes that the Design-builder thinks should be reflected in changes to the Contract Documents, the Design-builder shall produces the necessary changes via Change Order after notifying UCR of a potential Change Order(s).

D. Changes by Others: All changes to the Fed Model, subsequent to completion of the Work, including additional modeling by others, shall be solely the responsibility of the entity providing the changes or additions.

1.8 ASTM UNIFORMAT II CLASSIFICATION SYSTEM

A. Every Object in the Native Design Model shall have a classification code. The UNIFORMAT II system is a combination of letters, numbers and nomenclature, and is formatted as shown in the following example:

1. Level 1; Major Group Elements: for example: B Shell.

a. Level 2; Group Elements: for example: B20 Exterior Enclosure.

- Level 3; Individual Elements: for example: B2030 Exterior Door.

B. The Design-builder shall include the appropriate UNIFORMAT II classification in the list of attributes that is assigned to the Objects.

1.9 OMNICLASS CONSTRUCTION CLASSIFICATION

A. General: The OmniClass Construction Classification System (known as OmniClass or OCCS) is a classification system for the construction industry developed by the Construction Specification Institute (CSI). It builds upon MasterFormat for work results, UniFormat for elements and EPCI (Electronic product Information Cooperation) for structuring products. OmniClass is a reference library system that will serve as the foundation upon which information is transferred between the construction and operations phases.

B. OmniClass automatically assigned: The Design-builder shall include the appropriate OmniClass classification in the list of attributes that are automatically assigned to the Objects by the Model software.

C. Exception when OmniClass not automatically assigned: The Design-builder is not required to include the appropriate OmniClass classification in the list of attributes a discipline Native Model if that particular Native Model software does not automatically assigned the classification to its Objects. This exception applies only to the Native Model software that does not automatically assign the classification; for all other Native Models that do automatically assign the classification, it shall still be provided.

1.10 COMMISSIONING ~~AND COBIE REQUIREMENTS~~

A. General: If commissioning activities ~~and/or COBIE data~~ is required by other sections of these specifications, the Design-builder shall comply with the requirements of those sections in addition to the requirements of this section.

B. Commissioning requirements: The scope of work related to Commissioning, if required, shall be provided in accordance with the Commissioning section. In addition, and in support of, the extent of Model and Object parametric data required by this section shall be provided as described herein with modifications as follows:

1. The submittal of the Model data shall be as scheduled by the Commissioning requirements.

~~2. The Model data shall be formatted as required by the COBIE Data Sets requirements.~~

~~3. The submittal of the Model data shall be as scheduled by the COBIE requirements.~~

1.11 LEVEL OF DEVELOPMENT (LOD)

A. ~~The American Institute of Architects~~ BIMForum has developed a Level of Development (LOD) system which serves as the basis for this Project with Project-specific modifications as shown in the following requirements.

B. General: Regardless of LOD, the model(s) shall be capable of being presented in three dimensions, and shall be an object-based parametric database system.

C. LOD 100: ~~This is the "programming" level. Buildings and/or structures shall be modeled as masses indicative of area, height, volume, spatial location, and orientation.~~ The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.

D. LOD 200: ~~This is the "planning" level. Buildings and/or structures including major architectural, structural, mechanical, electrical, and plumbing objects shall be modeled as generalized systems or assemblies with approximate quantities, approximate configuration, spatial location, and orientation. Each enclosed space shall be identified as a unique Room with associated parameters.~~ The Model Element is graphically represented within the Model as a generic system, object or assembly with approximate quantities, size, shape, location, and orientation.

E. LOD 300: ~~This is the "design" level. Buildings and/or structures including all objects shall be modeled as specific systems or assemblies with accurate quantities, recognizable configuration, spatial location, and orientation. Each enclosed space shall be identified as a unique Room with associated parameters.~~ The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation.

F. LOD 350: The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, orientation, and interfaces with other building systems.

G. LOD 400: ~~This is the "construction" level. Buildings and/or structures including all objects shall~~

~~be modeled as specific systems or assemblies with accurate quantities, recognizable configuration, spatial location, and orientation, with complete fabrication, assembly, and detailing information. Each enclosed space shall be identified as a unique Room with associated parameters.~~ The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity and orientation with detailing, fabrication, assembly and installation information.

H. LOD 500: ~~This is the "as-built" level. Buildings and/or structures including all objects shall be modeled as constructed systems or assemblies with accurate quantities, shape, spatial location, and orientation, with complete fabrication, assembly, and detailing information. Each enclosed space shall be identified as a unique Room with associated parameters.~~ The Model Element is a field verified representation in terms of size, shape, location, quantity and orientation.

PART 2 – PRODUCTS

2.0 NATIVE MODEL SOFTWARE – MINIMUM REQUIREMENTS

A. General: The Native Model(s) shall be developed to include parametric components of major building and site elements as defined in this Section. All discipline Native Models shall be linked to the Architectural Native Model.

B. Accuracy of the Models: The Fed Model and each of its Native Models shall be developed to within a tolerance of ¼" plus or minus.

C. BIM application(s) and software(s) for the Fed Model shall:

1. Have maximum interoperability between systems models, and shall be fully compatible with the current version of Autodesk® Navisworks software.

2. Be provided in a format that is compatible with a free software download for viewing the Design-builder's models with the ability to save and track user annotations and notes.

3. Contain reports/logs of:

a. Discrepancies and/or clarifications in the Construction Documents identified during the modeling process.
b. Conflicts between location and alignment of model elements with resolutions developed by the Design-builder.
~~b. Quantities of modeled building element.~~
~~c. Schedule for each building element.~~

4. For any additional electronic model information that is not supported by the Revit or the primary software solution approved by UCR, and for constructing 4D models, the Design-builder shall utilize Navisworks software (Manage, Review, Simulate and Freedom) to create and utilize .nwd files.

D. The Design-builder shall use the latest version of Native Model software listed in the matrix below:

Acceptable Native Model Software Matrix		
Discipline	**Native Model Software**	**Comments**
Architectural	Revit Architecture	
Fixtures, and Equipment	Revit Architecture	Applies to stationary items only
Structural	Revit Structure	
HVAC	Revit MEP AutoCAD MEP CAD-Duct	
Plumbing	Revit MEP AutoCAD MEP CAD-Pipe	
Fire Protection	AutoSPRINK v 7	
Electrical	Revit MEP AutoCAD MEP	
Security Electronics	Revit MEP AutoCAD MEP	
Civil	AutoCAD Civil 3D	
Hardscape	Revit Architecture	

2.1 OBJECT IDENTIFICATION

A. General: Every Object in the Model shall have a Unique Identification (UID) parameter and a Common Name parameter attached to it in the Native Model.

~~B. Unique Identification: The UID shall be readable by the user of the Native Model software without additional software applications. The UID may be in the form of alpha, numeric, or alpha-numeric.~~

~~1. If the UID form is alpha-numeric, it shall be a consistent string format for all Objects, within its discipline, and shall be readable by any commonly available database. The UID is an "Instance" parameter.~~

~~2. If the Native Model software is not a full object-based, parametric, database platform, such as some of the older 3D CAD programs, the UID shall be attached to the Object manually, if necessary, so that it can be read by the user without additional software applications.~~

C. Common Name: ~~In addition to the UID,~~ Each Object shall have a Common Name parameter attached to it in the Native Model. ~~The Common Name shall be approved by UCR prior to modeling.~~ Examples of a Common Name include such as: door, window, toilet, VAV Box, etc. Typically, the Common Name will be generated automatically by the software, but if not, it shall be input manually in the Native Model. The common name will match the names in the various Contract Document Equipment Lists. The Common Name is an Object "Type" parameter.

2.2 OBJECT PARAMETRIC ATTRIBUTES – MINIMUM REQUIREMENTS

A. The following attributes shall be attached to each Object. Note: If a required attribute is not automatically generated by ~~Native~~ Design Model software, it shall be manually input in the ~~Native~~ Design Model, or provided in an Excel or Access document that includes the UID.

~~1. Unique Identification (Instance parameter).~~
2. Common Name (Type parameter).
3. Uniformat II Classification Code Levels 1, 2, and 3 (Type parameter).
4. Omni Code Classification – Excludes system families (Type parameter).
5. Native Model Assembly Code (Type parameter).
6. Manufacturer (where applicable) (Instance parameter).
7. Model Number (where applicable) (Instance parameter).

2.3 OBJECT ASSOCIATION

A. Every Object in the Design Model shall be associated with either a Room or a Floor and shall have an association "Instance" parameter attached to it in the ~~Native~~ Design Model.

B. Room association: Any Object that will be visible in a Room of the completed facility shall be associated with that specific Room. This includes all Objects regardless of responsible discipline; examples include without limitation: electrical switches and outlets, electrical switch gear and panel boards, plumbing equipment and fixtures, access panels to concealed Objects, cabinets, doors and frames, wainscot, light fixtures, HVAC supply and return grilles, fire sprinkler heads and valves, etc.

C. Floor association: Any Object that will be concealed in a wall or interstitial space (but would be visible if the finish surface or item was non-existent) shall be associated with the specific Floor level that it is within. This includes all Objects regardless of responsible discipline; examples include without limitation: electrical conduit, plumbing piping and valves, HVAC supply and return ducts, HVAC equipment, fire sprinkler lines and valves, etc.

D. Objects extending beyond Room boundaries: Floors, walls, and/or ceilings are sometimes modeled as objects that extend beyond individual Room boundaries. Where this occurs, the architectural discipline Native Model shall be modeled as follows:

1. Floors: Structural floor Objects may extend beyond Room boundaries, however, finish flooring such as carpet, resilient flooring, etc., shall be modeled as Objects, with extents contained within the Room boundaries, and with appropriate Room association.

2. Walls: Structural wall and non-structural partition Objects may extend beyond Room limits, however, the surface material such as gypsum wallboard, wall covering, etc., shall be modeled as Objects, or scheduled in the Room Finish Schedule, with extents contained within the Room boundaries, and with appropriate Room association.

3. Ceilings: Structural ceiling Objects may extend beyond Room limits, however, finish surface material such as gypsum wallboard, acoustical ceiling tiles, etc., shall be modeled as Objects, with extents contained within the Room boundaries, and with appropriate Room association.

2.4 BUILDING INFORMATION MODELING SYSTEM DISCIPLINE MODELS

A. Civil Systems: The Civil Systems Model shall be a sub-system model linked to the Architectural System Model. The Civil Systems Model shall serve as the basis for project shared coordinates through which the position of building elements on the site will be coordinated. Where applicable, provide model Objects of:

1. Topography: 1) existing natural and/or graded contours, and 2) new grades and finish contours.

2. Planting: 1) existing major landscaped areas, 2) existing trees to remain, 3) new landscaped areas, 4) new trees, and 5) irrigation lines over 2" diameter.

3. Surface Improvements: 1) pavements, 2) curbs and gutters, 3) retaining walls, and 4) exterior non-building structures such as tanks, shade structures etc.

4. Existing Structures: 1) all buildings within the project area intended to remain, 2) buildings intended to be demolished. All existing structures may be modeled exterior surface only; interior elements are not required.

5. Storm Water and Sanitary Sewers: 1) existing lines (over 3" diameter), boxes and structures within project area, 2) all new lines, boxes and structures and 3) existing public lines, boxes and structures beyond the project area but serving as points of connection for the project.

6. Utilities: 1) existing domestic and fire water main and branch lines (2" and larger diameter) within project area, 2) all new domestic and fire water lines, 3) existing electrical overhead and underground lines within project area, all new electrical lines outside buildings, 4) existing telephone and data lines within project area, 5) all new telephone and data lines outside buildings, 6) existing gas lines within project area and, 7) all new gas lines outside buildings.

7. Other requirements:

   a. Quantities: data to reflect accurate quantities of the above elements.
   b. Schedules: data for installation of the above elements.

B. Architectural Systems: The Architectural Systems Model shall be the primary model to which others are linked. Provide model Objects of:

1. Spaces: 1) net square footage of all occupied spaces, 2) gross constructed floor area, 3) room names and numbers, and 4) floor, base, wall, and ceiling finishes. NOTE: Model room names and numbers shall match UCR's Architectural Program space names and numbers.

2. Exterior Walls and Curtain Walls: 1) type and composition, 2) height, length, and width, and 3) thermal, acoustic, fire, and security ratings.

3. Partitions: 1) type and composition, 2) height, length, and width and, 3) thermal, acoustic, fire, and security ratings.

4. Floors: 1) type and material, 2) thickness and 3) Finishes with manufacturer's name and product numbers. Link floor structure to the Structural Systems Model.

5. Ceilings: 1) type and composition, 2) height, length, and width, and 3) ~~thermal, acoustic,~~ fire~~, and security~~ ratings.

6. Roof Coverings and Openings: 1) configuration, 2) drainage system, and 3) penetrations for modeled building components.

7. Exterior Doors, Windows, and Louvers: 1) type and material, 2) height, width, and thickness, 3) ~~thermal, acoustic,~~ fire~~, and security~~ rating, 4) location and, 5) hardware elements or group.

8. Interior Doors, Windows, and Louvers: 1) type and material, 2) height, width, and thickness, 3) ~~thermal, acoustic,~~ fire~~, and security~~ rating, 4) location, and 5) hardware elements or group.

9. Stairs and Ramps: 1) stairs and railings, 2) ramps and railings, and 3) handrails and guardrails.

10. Elevators ~~and Escalators~~: 1) elevator cabs and doors, 2) elevator hoist-way doors and trim, 3) elevator machinery and equipment, ~~4) escalator belts and railings, and 5) escalator machinery and equipment.~~

11. Casework and Counters: 1) type and material, 2) height, width, and depth, 3) location, and 4) hardware.

~~12.~~ Plumbing Fixtures: 1) type and material, 2) location, 3) trim, and 4) finishes~~: Link fixtures and trim to the Mechanical Systems Model.~~

13. HVAC Grills and Registers: 1) type and material, 2) location, 3) trim, and 4) finishes: Link fixtures and trim to the Mechanical Systems Model.

14. Electrical Fixtures and Equipment: 1) type and material, 2) bulb type and wattage, 3) location, 4) trim, and 5) finishes: Link fixtures and trim to the Electrical Systems Model.

15. Miscellaneous Fittings: 1) toilet partitions, 2) toilet room accessories, 3) personal storage lockers, 5) display cases, and 6) other surface applied quasi-permanent items such as mirrors etc.

~~16. Other requirements:~~

~~a. Quantities: data to reflect accurate quantities of the above elements.~~
~~b. Schedules: data for installation of the above elements.~~

C. Structural Systems: The Structural Systems Model shall be a sub-system model linked to the Architectural System Model. Provide model Objects of:

1. Foundations and footings: 1) type and configuration, and 2) depth, length, and width.

2. Slab(s) on-grade: 1) type and configuration, 2) under-slab base and waterproofing, 3) recesses, curbs, pads, closure pours, and 4) major penetrations.

3. Basement Walls: 1) type and composition, and 2) height, length, and width, ~~and 3) thermal, acoustic, fire, and security ratings.~~

4. Elevated Floors: 1) columns and beams, 2) primary and secondary framing members, 3) bracing, and 4) ~~connections, and 5)~~ ramed, composite, and/or slab decks.

5. Roofs: 1) columns and beams, 2) rimary and secondary framing members, 3) bracing, and 4) ~~connections, and 5)~~ framed, composite, and/or slab decks.

6. Joints: 1) expansion and/or contraction, and 2) seismic.

7. Stairs and Ramps: 1) openings and framing, and 2) railing supports.

8. Shafts and Pits: 1) openings and framing, and 2) railing supports.

9. Other requirements:

~~c. Quantities: include data to reflect accurate quantities of the above elements.~~

~~d. Schedules: data for installation of the above elements.~~

e. Fireproofing: Fireproofing is not to be included in the BIM but clash detection studies shall include definition of tolerances for conflict detection.

f. Color Code: color code structural steel from other elements.

D. Mechanical/Plumbing: The Mechanical and Plumbing Systems Models shall be a sub-system model. Design Models shall be linked to the Architectural System Model. Provide model Objects of:

1. Heating, Ventilating, and Air Conditioning: 1) all heating, ventilating, air-conditioning, exhaust fans, and specialty equipment, 2) air supply, return, ventilation and exhaust ducts, including space-consuming elbows and transitions, 3) fire dampers with ratings, 4) mechanical piping, ~~and~~ 5) registers, diffusers, grills and hydronic baseboards, and 6) BMS panels. Design Models shall ~~C~~coordinate and link fixtures and trim to the Architectural Systems Model.

2. Plumbing: 1) all domestic plumbing piping and fixtures, 2) floor and area drains, 3) valves (regardless of pipe size) and 4) related equipment.

a. Piping larger than 1 .5" diameter shall be modeled.

3. Roof Drainage: 1) all piping and fixtures, and 2) related equipment.

   a. Piping larger than 1 .5" diameter shall be modeled.

4. Other requirements:

   ~~a. Quantities: data to reflect accurate quantities of the above elements.~~

   ~~b. Schedules: schedule data for installation of the above elements.~~

   c. Equipment Clearances: Clearances for major equipment and all M/E/P Equipment and Architecturally Significant Specialty Equipment, as model objects for conflict detection and maintenance access requirements.

   d. Color Code: separate color code for each type element.

E. Electrical and Low Voltage: The Electrical and Low Voltage Systems Model shall be a sub-system model linked to the Architectural System Model where applicable. Provide model Objects of:

1. Interior Electrical Power and Lighting: 1) all interior electrical components, 2) ~~lighting, receptacles,~~ special and general purpose power receptacles, 3) lighting fixtures, 4) panel-boards and control ~~systems~~ boards, and 5) conduit and cable trays.

   a. Individual conduit larger than 1 .5" diameter shall be modeled.
   b. Groups or clusters runs, and cable trays of conduit of all sizes shall be modeled.

2. Exterior Building Lighting: 1) all exterior electrical components, 2) ~~lighting, receptacles,~~ special and general purpose power receptacles, 3) lighting fixtures, 4) panel-boards and control ~~systems~~ boards, and transformers, and 5) utility connection and equipment.

   a. Individual conduit larger than 1 .5" diameter shall be modeled.
   b. Grouped or clustered runs of conduit of all sizes shall be modeled.

3. Telephone, Data, Television, and Other Low Voltage: 1) all interior low voltage components, 2) outlets, receptacles, special and controls, 3) fixtures, 4) panel-boards, and equipment racks, ~~and control systems,~~ and 5) conduit and cable.

   a. Individual conduit larger than 1 .5" diameter shall be modeled.
   b. Groups or clusters runs of conduit of all sizes shall be modeled.

4. Other requirements:

   ~~a. Quantities: data to reflect accurate quantities of the above elements.~~
   ~~b. Schedules: schedule data for installation of the above elements.~~
   c. Equipment Clearances: Clearances for major as model objects for conflict detection and maintenance access requirements.
   d. Color Code: separate color code for each type element.

F. Fire Suppression: The Fire Suppression Systems Model shall be a sub-system model linked to the Architectural System Model. Provide model Objects of:

1. Fire Suppression System: 1) valves and risers, 2) all main, branch, and drains lines, 3) sprinkler heads, and fittings, and 4) pumps.

2. Fire Alarms: 1) alarm and notification devices, and 2) detection systems.

3. Other requirements:

~~a. Quantities: data to reflect accurate quantities of the above elements.~~
~~b. Schedules: schedule data for installation of the above elements.~~
c. Equipment Clearances: Clearances for major equipment as model objects for conflict detection and maintenance access requirements.
d. Color Code: separate color code for each type element.

G. Specialty Equipment: The Specialty Equipment Model shall be a sub-system model linked to the Architectural System Model. Specialty Equipment includes without limitation such specialties as: service equipment and systems, ~~concessions / food service~~ laboratory equipment and systems, security equipment and systems, conveyance equipment and systems, ~~manufacturing equipment and systems,~~ etc. Provide model Objects of:

1. Specialty Equipment: 1) equipment, 2) related mechanical, plumbing, and electrical requirements.

~~a. Quantities: data to reflect accurate quantities of the above elements.~~
~~b. Schedules: schedule data for installation of the above elements.~~
c. Equipment Clearances: equipment clearances as model objects for conflict detection and maintenance access requirements.

2.5 ~~COST AND~~ SCHEDULE INFORMATION

A. Fed model with 4D ~~and 5D~~ Data shall be ~~submitted with the Phase 2 preliminary and baseline schedule submittals and~~ updated monthly ~~thereafter~~. Continuously update ~~cost and~~ schedule information in the BIM model so that information provided monthly in the payment application and schedule update is reflective of the project's progress as stated in the monthly submissions. Refer to the General Conditions for cost and schedule requirements.

B. Schedule Data (4D):

1. Provide construction activity sequences, including ~~rough-in, finish, and phasing schedules for major elements of all models~~ milestone activities noted in Section 1.1 of this specification.

~~2. Breakdown the schedule of elements by individual Subcontractors.~~

~~3. Link the activity sequence to the Schedule of Values~~

~~C. Cost Data (5D):~~

~~1. Provide quantity based, installed cost breakdown of labor and material for major elements of all models.~~

~~2. Provide a complete Schedules of Values based on the models.~~

~~3. Link data to the Project Cost Database in Microsoft Excel format.~~

PART 3 – EXECUTION

3.1 DEVELOPMENT AND SUBMITTAL OF THE MODELS

A. BIM Submittal Execution: The Design-builder shall develop the Fed Model and its discipline systems Native Models in compliance with the Contract Documents and the following:

1. Develop and submit all of the discipline systems Native Models concurrently. Note: if any of the discipline systems Native Models qualify as deferred approvals, they may be submitted separately.

2. Submit the Fed Model with 300 LOD at ~~60%~~ each phase of completion of the Work of the Project for UCR's review and coordination.

3. Submit updated Fed Model and all linked Native Models at any time when the Design-builder requests changes and/or clarifications.

4. Submit ~~fully~~ a completed Fed Model and its systems models for specific areas, prior to construction. Multiple submissions will be required as coordination will still be ongoing as construction starts.

5. Submit updated discipline systems Native Models complying with final approved shop drawing submittals.

6. Submit the "as-built" Fed Model and its discipline systems Native Models as part of the close-out process.

3.2 UPDATING MODELS DURING CONSTRUTION:

A. The BIM Model shall be routinely updated/revised to keep it current with construction activity.

1. Design Model: The design model shall be updated no less than every month and after the issuance of the following:
   a. Instruction Bulletins
   b. Drawing Packages
   c. Significant RFI Responses

2. Construction Model: The construction model shall be updated monthly with any changes per section 1.5 B of this specification.

~~3. Revising: issue the revised Fed Model and/or its discipline systems Native Models immediately after each meeting or other activity where revisions have been made. Include a report that indicates every change.~~

B. Submit the updates and revisions to UCR.

C. Closeout Requirements:

1. Refer to the "Project Closeout" PR for Requirements.

END OF SECTION 01-1300

SECTION 01 1400 – DESIGN BUILDER'S USE OF THE PROJECT SITE

PART 1 - GENERAL

1.1 USE OF PUBLIC THOROUGHFARES AND UNIVERSITY ROADS

A. Design Builder shall make its own investigation of the condition of available public thoroughfares and University roads, and of the clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress at the Project site.

B. Where materials are transported in the prosecution of the Work, do not load vehicles beyond the capacity recommended by manufacturer of the vehicles or prescribed by any applicable state or local law or regulation.

C. Use only established roads on the campus; provided, however, that such temporary haul roads as may be required in the work shall be constructed and maintained by Design Builder, subject to the approval of University's Representative. Refer to Section 01 3540 Environmental Mitigation and 01 7419 Construction Waste Management for descriptions of the Design Builder's requirements for providing an approved haul route plan to and from the campus.

D. Provide protection against damage whenever it is necessary to cross existing sidewalks, curbs, and gutters in entering upon the University roads and public thoroughfares. Repair and make good immediately at the expense of Design Builder all damages thereto, including damage to existing utilities and paving, arising from the operations under the Contract.

E. Truck staging is not allowed on campus or on any residential street surrounding the campus.

1.2 WATCHMAN'S SERVICES

A. The University will not be providing security services for the Project.

B. During all hours that Work is not being prosecuted including weekends and holidays, furnish such watchman's services as Design Builder may consider necessary to safeguard materials and equipment in storage on the Project site, including Work in place or in process of fabrication, against theft, acts of malicious mischief, vandalism, and other losses or damages.

C. The University will not be liable for any loss or damage.

1.3 SERVICE CONTINUITY

A. Within the areas of the Work, investigate and uncover all drainage lines, sewers, electrical ducts, and other piping in use or forming continuations or utility systems

required for other buildings or improvements upon the campus, and maintain such services in operation during performance of the Work of the Contract.

B. Maintain continuous services to all existing facilities during the period of construction except for the following conditions:
   1. Perform Work that involves "shut-down" of existing facilities at such times as will cause the least inconvenience to the University activities, performing at night, on Saturdays, Sundays, holidays and at the discretion of University's Representative. Furnish University's Representative written notice of exact date and time of "shut-down" at least thirty (30) working days in advance, unless a longer period is specified or agreed upon by the University. On jobs with short performance time, Design Builder shall verify with University's Representative the number of days required in advance for shut-down.
   2. The Design Builder shall include in the base bid all costs related to overtime necessary for the Work. No extra payment will be allowed for overtime to meet this requirement or the Contract Schedule.

1.4 SITE DECORUM

Design Builder shall control the conduct of its employees (including subcontractor's employees) so as to prevent unwanted interaction initiated by Design Builder's employees with University of California, Riverside (UCR) students, UCR staff, UCR Faculty or other individuals (except those associated with the Project), adjacent to the Project site. Without limitation, unwanted interaction by Design Builder employees would include whistling at or initiating conversations with passersby. In the event that any Design Builder employee initiates such unwanted interaction, or utilizes profanity, Design Builder shall, either upon request of University's Representative or on its own initiative, replace said employee with another of equivalent technical skill, at no additional cost to the University. No recreational/music radio sounds, other than two-way communication type, shall be audible outside the physical structure under construction. UCR is a non-smoking campus.

1.5 STORAGE

A. Design Builder's use of the Project site for the Work and storage is restricted to the areas required for the performance of the Contract or as approved by University's Representative.

1.6 TEMPORARY STAIRS, SCAFFOLD AND RUNWAYS

A. Provide all scaffolds, stairs, hoist plant, runways, platforms, and similar temporary construction as may be necessary for the performance of the Contract. Such facilities shall be of the type and arrangement as required for their specific use, substantially constructed throughout and strongly supported, well secured and complying with all applicable rules and regulations of the Industrial Accident Commission of the State of California and all applicable laws and ordinances. Refer to Section 01 4100, Regulatory Requirements.

B. Arrange for construction equipment access to areas which may be partly blocked by existing obstructions.

1.7 CONTROL OF CONSTRUCTION WATER

A. Provide impermeable floor coverings and suitable dams to prevent damage by water used for the Work. Immediately clean up and remove all surplus water and water spilled in non-working areas. Do not allow water to overflow gutters, flood streets or parking lots.

1.8 DUST CONTROL, AIR POLLUTION AND ODOR CONTROL

A. The Design Builder shall employ measures to prevent the creation of dust, air pollution and odors.

1. Unpaved areas where vehicles are operated shall be periodically wetted down or given an equivalent form of treatment as defined in South Coast Air Quality Management District (SCAQMD) Rule 403 to eliminate dust formation.
2. All volatile liquids including fuels or solvents shall be stored in closed containers.
3. No open burning of debris, lumber or other scrap will be permitted.
4. Equipment shall be maintained in a manner to reduce gaseous emission.
5. Low sulfur fuel shall be used for construction equipment.
6. Stockpiles of excavated materials shall be protected and covered with material to prevent airborne transmission.
7. Design Builder shall provide street sweeping whenever silt from construction site is carried over to adjacent streets.

1.9 NOISE CONTROL

A. Noise control shall be maintained by the Design Builder in all areas of construction, guarding against any undue noise which may impair proper use of adjacent facilities. Activities with the highest noise potential shall be scheduled for times when background ambient noise levels are highest (i.e., during peak commute hours). Design Builder shall use noise suppressed equipment available and/or shall muffle/control noise on equipment to the maximum extent possible. Noisy construction-related operations (e.g. mixing concrete) shall be accomplished off-site to the extent feasible. Those operations which cannot be performed off-site shall be done on those areas of the site furthest from noise sensitive receptors.

B. The following noise control procedures shall be employed:

1. Maximum Noise: The Design Builder shall use equipment and methods during the course of this work that are least disruptive to adjacent offices or residences. Noise levels for trenchers, graders, trucks and pile drivers shall not exceed 90 dBA at 50 feet as measured under the noisiest operating conditions. For all other equipment, noise levels shall not exceed 85 dBA at 50 feet.
2. Equipment: Jack hammers shall be equipped with exhaust mufflers and steel muffling sleeves. All diesel equipment shall have exhaust muffled. Air compressors shall be of a quiet type such as a "whisperized" compressor.

3. Operations: Machines shall not be left idling. Electric power shall be used in lieu of internal combustion engine power wherever possible. Equipment shall be maintained to reduce noise from vibration, faulty mufflers, or other sources.
4. Scheduling: Noisy operations shall be scheduled so as to minimize the disturbance and duration to adjacent neighborhoods and nearby student Housing complexes.

1.10 EROSION CONTROL

A. Exposed earth surfaces shall be watered to minimize dust generation as necessary according to weather conditions.

B. During winter construction, an erosion and sediment-transport control plan incorporating standard erosion control practices shall be implemented prior to the first day of earth moving activities.

1. Erosion control shall include retaining sediments within project site by the use of catch basins; using interceptor ditches and benches to prevent gullying of slopes; and preparing and implementing erosion control plans.

C. Storm Water Pollution Prevention Plan (SWPPP):

1. Design Builder to obtain all necessary SWPPP permits and designate a Qualified SWPPP Practitioner (QSP) to oversee the project. The Design Builder shall retain and oversee the QSP for the duration of the schedule until Substantial Completion of Phase 2.

1.11 TRENCHING SHORING:

A. Protection. Pursuant to Labor Code Sections 6705 and 6707, Design Builder shall include in its base bid all costs incident to the provision of adequate sheeting, shoring, bracing or equivalent method for the protection of Life and Limb which shall conform to the applicable Federal and State Safety Orders.

B. Before beginning excavation five feet or more in depth, Design Builder shall provide to University's Representative a detailed plan showing the design or shoring, bracing, sloping, or other provisions to be made for worker protection from the hazards of caving ground during the excavation. The proposed plan shall comply with the State of California Construction Safety Orders, Title 8 and Title 24 of the California Code of Regulations. (CCR). The detailed plan shall be prepared by a registered civil or structural engineer registered in the State of California. The cost of required engineering services shall be borne by Design Builder and shall be deemed to have been included in the base bid for the Work.

C. The receipt of any plan showing the design of shoring, bracing, sloping, or other provisions for worker protection shall not relieve Design Builder from its obligation to comply with Construction Safety Orders Standards and Title 24 CCR for the design and construction of such protective Work, and Design Builder shall indemnify University and University's Representative from any and all claims, liability, costs, action and causes of action arising out of or related to the failure of such protective systems.

Design Builder shall defend University, its officers, employees, and agents and University's Representative in any litigation of proceeding brought with respect to the failure of such protective systems.

D. Comply with State of California Construction Safety Orders, Article 6 - Excavations, Trenches, Earthwork - whether or not the excavation, trench, or earthwork is five feet or more in depth.

END OF SECTION 01 1400

SECTION 01 2100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances.

1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
2. Include in the Lump Sum Base proposal, all Allowances stated in the Contract Documents. Items covered by Allowances shall be supplied for such amounts and by such persons or firms as University's Representative may direct.

B. Types of allowances include the following:

1. Lump-sum allowances.

C. Related Sections include the following:

1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
2. Divisions 02 through 33 Sections for items of Work covered by allowances.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise University's Representative of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At University's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by University's Representative from the designated supplier.

1.3 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities and prices of materials delivered to the site for use in fulfillment of each allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.4 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.5 LUMP-SUM ALLOWANCES

A. Allowance shall include the cost to Design Builder of specific products and materials ordered by University under allowance and shall include taxes, freight, and delivery to Project site. Design Builder shall only be compensated for the actual cost incurred.

B. Design Builder's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by University under allowance shall be included as part of the Lump Sum Base proposal and not part of the allowance.

1.6 UNUSED MATERIALS

A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to University, after installation has been completed and accepted.

1. If requested by University's Representative, prepare unused material for storage by University when it is not economically practical to return the material for credit. If directed by University's Representative, deliver unused material to University's storage space. Otherwise, disposal of unused material is Design Builder's responsibility.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Partnering – Allow $20,000 for project partnering expenses, including meals, rentals, etc. during the project.

B. Allowance No. 2: Signage – Allow $200,000 for building signage.

1. Exterior Signage – Building identification and number per Campus Standards.. Allowance is for labor and materials.
2. Interior Signage – Code required signage shall be included in the base bid and is not part of this allowance.
3. Other interior signage will be provided and installed by others and is not part of this allowance.

C. Allowance No. 3: Design Refinements – Allow $400,000 for University directed design refinements/clarifications.

1. Allowance shall be used to refine the architectural design in material type, use, detailing and interface as directed by the University for the purpose of improving architectural character and quality of the building. Design Builder shall provide detailed cost breakdowns for cost per section 01 2100.1.3.A.

D. Allowance No 4: Fit out of distributed core – Allow $1,375,000 for equipment and infrastructure refinements/clarifications.

1. Allowance shall be used to refine the mechanical, electrical, plumbing, telecommunication and architectural finish installation requirements of five (5) 660 sqft distributed core spaces (5 x $275,000 each) prior to beneficial occupancy.

E. Allowance No 5: Fit Out of Imaging Core – Allow $2,200,000 for infrastructure refinements/clarifications.

1. Allowance shall be used to refine the mechanical, electrical, plumbing, telecommunication and architectural finish installation requirements of centralized imaging core spaces prior to beneficial occupancy.

F. Allowance No 6: Fit Out of Wet Laboratory Spaces – Allow $400,000 for equipment infrastructure refinements/clarifications.

1. Allowance shall be used to refine the mechanical, electrical, architectural finish and telecommunication installation requirements as directed by researchers assigned to MRB1 for the wet labs (40 x $10,000 each) prior to beneficial occupancy.

G. Allowance No 7: Hammer-Throw Course – Allow $50,000 for relocation of existing hammer-throw course.

1. Allowance shall be allocated to build in-kind hammer-throw course in a location on campus to be determined by University.

a. Design-builder to disassemble, salvage, and transport to temporary storage facility (determined by University) protective fencing materials used for existing hammer-throw course located in near vicinity of project building (proposed laydown and staging area).
b. Existing concrete pad may be utilized at the discretion of Design-builder during the performance of the Work but shall be demolished and removed/recycled off campus prior to project turn-over to University.

END OF SECTION 01 2100

SECTION 01 2200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections include the following:

1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.2 DEFINITIONS

A. Unit price is an amount proposed by Design Builder, stated on the Price Proposal, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by Change Order, if estimated quantities of Work required by the Contract Documents are increased or decreased beyond the base contract scope.

1.3 PROCEDURES

A. Unit prices shall include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, profit, operable modifications according to the Contract Documents, cost of coordinating the unit price work with adjacent work, compensation for risk of loss or damage to the work regardless of cause, and all expenses due to delays in performance.

B. The Unit Prices shall not apply to work the Design Builder elects to do for its own convenience or to correct errors committed by the Design Builder.

C. Unit Prices remain in effect during the Contract Time and will be used to adjust the Contract Sum.

D. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

E. University reserves the right to reject Design Builder's measurement of work-in-place that involves use of established unit prices and to have this work measured, at University's expense, by an independent surveyor acceptable to Design Builder.

F. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

A. Unit Price No. 1 - Daily Rate of Compensation for Compensable Delays:

1. Description: Proposing Design Builder shall determine the amount of per diem compensation for any Compensable delay as defined in Articles 7 and 8 of the General Conditions.
2. Unit of Measure: One calendar day.
3. Multiplier: Sixty calendar days.

B. Unit Price No. 2 - Over-Excavation:

1. Description: Excavation and disposal of additional earth, in accordance with Division 31 Section, "Earth Moving".
2. Unit of Measure: Cubic yard of material removed and disposed.
3. Multiplier: 100 cubic yards.

C. Unit Price No. 3 - Backfill and Compaction for Over excavation:

1. Description: Placement and compaction of additional backfill, in accordance with Division 31 Section, "Earth Moving".
2. Unit of Measure: Cubic yard of material placed and compacted.
3. Multiplier: 50 cubic yards.

D. Unit Price No. 4 - Trenching, Backfilling and Compacting for Utilities:

1. Description: Trenching for utilities, placement and compaction of backfill, in accordance with Division 31 Section, "Earth Moving".
2. Unit of Measure: Cubic yard of material removed during trenching, placement and compaction of backfill.
3. Multiplier: 50 cubic yards.

E. Unit Price No. 5 – Fixed Laboratory Casework:

1. Description: Workstation / bench length per person: 6-feet long x 30-inches deep with countertops or work surface consistent with the requirements of Wet Lab 2 as described in Basis of Design document section 3.2, Laboratory Design Criteria.
2. Unit of Measure: One workstation / bench with side/closer panels as required delivered and installed on site.
3. Multiplier: Six units

F. Unit Price No. 6 – Mobile Laboratory Bench & Casework System:

1. Description: Workstation / bench length per person: 6-feet long x 30-inches deep with countertops or work surface consistent with the requirements of Flex Lab 2 as described in Basis of Design document section 3.2, Laboratory Design Criteria.
2. Unit of Measure: One workstation / bench delivered and installed on site.
3. Multiplier: Six units

G. Unit Price No. 7 –Laboratory Mobile Tables:

1. Description: 6-feet long x 30-inches deep, height adjustable (between 30-inches and 36-inches) with work surface consistent with the requirements of mobile tables as described in Basis of Design document section 3.2, Laboratory Design Criteria.
2. Unit of Measure: One height adjustable mobile table delivered and installed on site.
3. Multiplier: Six units

H. Unit Price No. 8 – Biological Safety Cabinets (BSC):

1. Description: 6-foot Class II/Type A2 BSC with automatic sash positioning configured as 70% recirculating and 30% exhausted into the room installed consistent with the requirements of primary containment as described in Basis of Design document section 3.2, Laboratory Design Criteria.
2. Unit of Measure: One BSC delivered and installed on site.
3. Multiplier: Ten units.

END OF SECTION 01 2200

SECTION 01 2300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by Design Builder and stated on the Price Proposal Form for certain work defined in the Proposal Requirements that may be added to or deducted from the Lump Sum Base Proposal amount if the University decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
2. Design, engineering, coordination, labor, materials, equipment, accessories, and Design Builder and subcontractor overhead, mark-up and profit required for the alternate work shall be included in the Alternate cost.

1.3 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

E. Contract Time: Complete accepted Alternates with the time stipulated for the Work in the Agreement unless specifically provided by the University.

F. Hold the Alternates price for each Alternate for time indicated in the Alternate description beyond the date stated in the Notice to Proceed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Additional PI Research Wet Labs

i. No. 1A - Two (2) additional PI Research Wet 1 Labs
ii. No. 1B - Two (2) additional PI Research Wet 1 Labs
iii. No. 1C - Two (2) additional PI Research Wet 1 Labs

2. Provide all labor, material, equipment, design costs, subcontractor and Design Builder mark-up, overhead and profit for additional Principle Investigator research Wet Lab(s) to the MRB1 facility built as required in the base bid.
3. See Technical Proposal for details.
4. Award will be made concurrent with the Notice to Proceed for Phase I.

B. Alternate No. 2: Additional Building Vivarium Shell

1. Provide all labor, material, equipment, design costs, subcontractor and design-builder mark-up, overhead and profit for additional 5,000 GSF of future expansion tenant improvements space adjacent to the vivarium built as required in the base bid.
2. See Technical Proposal for details.
3. Award will be made concurrent with the Notice to Proceed for Phase I.

C. Alternate No. 3: Additional Building Shell Space

1. Provide all labor, material, equipment, design costs, subcontractor and design-builder mark-up, overhead and profit for adding 10,000 GSF of future expansion tenant improvements space to the MRB1 facility built as required in the base bid.
2. See Technical Proposal for details.
3. Award will be made concurrent with the Notice to Proceed for Phase I.

D. Alternate No. 4: Extend North Service Road

1. Provide all labor, material, equipment, design costs, subcontractor and design-builder mark-up, overhead and profit for replacing fire department access hammerhead termination as required in the base bid. Extend project built north service road (off Aberdeen) westward and connect to existing UCR Parking Lot 25 to accommodate circuitous fire access route.
2. See Technical Proposal for details.
3. Design Builder shall hold this alternate for 90 calendar days beyond the date of the Notice To Proceed for Phase I.
4. Refer to University Furnished Information, item #10 – *Area of Work* schematic provided in Addendum #4

E. Alternate No. 5: LEED Gold Certification

1. Provide the design and construction required to obtain a LEED "Gold" certification from the U.S. Green Building Council for this project.
2. The base bid package for the project establishes the minimum requirements (as described in Section 01 8113) to achieve LEED "Silver" certification from the U.S. Green Building Council. As part of this alternate, the Design Builder shall be required to take the necessary steps for improving the project design, operation and construction procedures and documentation procedures to receive the "Gold" certification from the U.S. Green Building Council. The Design Builder shall bear all cost for LEED Gold certification
3. Award will be made concurrent with the Notice to Proceed for Phase I.

F. Alternate No. 6: LEED Platinum Certification

1. Provide the design and construction required to obtain a LEED "Platinum" certification from the U.S. Green Building Council for this project.
2. The base bid package for the project establishes the minimum requirements (as described in Section 01 8113) to achieve LEED "Silver" certification from the U.S. Green Building Council. As part of this alternate, the Design Builder shall be required to take the necessary steps for improving the project design, operation and construction procedures and documentation procedures to receive the "Platinum" certification from the U.S. Green Building Council. The Design Builder shall bear all cost for LEED Gold certification
3. Award will be made concurrent with the Notice to Proceed for Phase I.

G. Alternate No. 7A: Laboratory Air Monitoring System

1. Provide all labor, material, equipment, design costs, subcontractor and design-builder mark-up, overhead and profit to install Aircuity air sampling and monitoring system including the following.
   i. Install new Aircuity devices to monitor laboratory and Vivarium spaces. Installation shall be complete with all required control and monitoring system panels, modules, cards, networking equipment and all other required devices. Achieve complete integration and common reporting of entire building as one system installation.
   ii. Remote site connection to campus system for monitoring and reporting of alarms and status.
2. All work shall be completed per the design criteria and specifications included in the Bid Documents.
3. Award of University-selected Alternates will be within 30 days after the Notice To Proceed of Phase I.

H. Alternate No. 7B: 24 Month Service & Maintenance of Laboratory Air Monitoring System

1. Provide twenty-four (24) months of service and maintenance of laboratory and vivarium air monitoring system. Monitoring and service will be coordinate with both UCR's Facilities Management and Environmental Health and Safety departments.

2. Commissioning of Aircuity shall comply and coordinate with the building commissioning requirements of the RFP.
3. Training on the Aircuity system of both Facility Management and Environmental Health and Safety staff shall comply with the RFP requirements for startup and provide on-going training to staff as necessary to insure the University's staff can proficiently operate and manage the Aircuity system. A minimum of six (6) shall be trained on the service and management of the system.
4. The awarded Design Builder shall provide real-time logs of the system operations and provide remedy to operational failures as required by code, EH&S or Facilities.
5. All work shall be completed per the design criteria and specifications included in the Bid Documents.
6. Award of University-selected Alternates will be within 30 days after the Notice To Proceed of Phase I.

I. Alternate No. 8: Zebrafish Lab Fit-out

1. To better isolate & identify scope and associated costs, Zebrafish Lab Fit-out, as identified in Addendum #8 is redirected as an ALTERNATE. Provide all labor, material, design costs, subcontractor and design-builder mark-up, overhead and profit to fit-out one (1) 660 sqft distributed core 'garage' to accommodate OFOI equipment and supplies for a Zebrafish Laboratory (both holding and quarantine).
   i. Lab location to be determined by Design Build Team with regard to adjacencies, efficiency and cost effectiveness.
2. All structural, mechanical, electrical, plumbing, and utilities identified in the Zebrafish Basis of Design shall be included in the fit-out. All work shall be completed per the design criteria and specifications included in the Bid Documents.
3. Award of University-selected Alternates will be within 30 days after the Notice To Proceed of Phase I.

END OF SECTION 01 2300

SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 01 Section "Allowances" for procedural requirements for handling and processing allowances.
2. Division 01 Section "Unit Prices" for administrative requirements for using unit prices.
3. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.2 PROPOSAL REQUESTS

A. University-Initiated Proposal Requests: University's Representative will issue a Bulletin to detail any proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the Bulletin will include supplemental or revised Drawings and Specifications. Comply with requirements of the General Conditions, Article 7 "Changes in the Work."

1. Bulletins issued by University's Representative are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change, unless directed otherwise on the Bulletin.

B. Within time specified in General Conditions after receipt of Bulletin, submit a Cost Proposal for adjustments to the Contract Sum and the Contract Time necessary to execute the change.

C. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

D. Design Builder-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Design Builder may propose changes by submitting a request for a change to University's Representative. Comply with the requirements in the General Conditions, Article 4, paragraph 4.2.

E. Cost Proposal Request Form: Use forms provided by University. Sample copies are included with the Exhibits.

1.3 ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents in accordance with General Conditions, Article 4.

1.4 CHANGE ORDER PROCEDURES

A. On University's approval of a Cost Proposal Request, University's Representative will issue a Change Order for signatures of Design Builder on form included in the Exhibits.

B. Provide all necessary backup information regarding expenditures and quantities associated with the Change Order Proposal Request as University's Representative may require.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Cost Breakdown and Applications for Payment.

B. Related Sections include the following:

1. Division 01 Section "Allowances" for procedural requirements governing handling and processing of allowances.
2. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Division 01 Section "Unit Prices" for administrative requirements governing use of unit prices.
4. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Design Builder's Contract Schedule and Submittals Schedule.

1.2 COST BREAKDOWN

A. Coordination: Coordinate preparation of the Cost Breakdown with preparation of Design Builder's Contract Schedule and General Conditions Article 9 paragraph 9.1.

1. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the University’s standard form, included with Application for Payment, Schedule 1. Project Manual table of contents should be used as a guide to establish line items for the Cost Breakdown.

1. Design Builder’s standard form or media-driven printout will be considered on request.
2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide several line items for principal subcontract amounts, where appropriate.
3. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
4. Provide a separate line item in the Cost Breakdown for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not installed. Refer to General Conditions, Article 9, paragraph 9.3.5.

    a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing.

5. Provide a separate line item for mobilization that shall not exceed 1½% of the Contract Sum. Mobilization shall consist of preparatory Work and operation. This shall include but not limited to: providing bonds; insurance; financing; initial movement of personnel, equipment, supplies, and incidentals to establishment offices and other facilities and for other operations or costs incurred prior to beginning Work on the various Contract items at the project site.
6. Provide separate line items in the Cost Breakdown for initial cost of materials, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the Cost Breakdown for each allowance.
8. Each item in the Cost Breakdown and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
9. Schedule Updating: Update the Cost Breakdown with each Application for Payment when Change Orders result in a change in the Contract Sum.

C. Substantiating Data: University's Representative may require substantiating information; submit data justifying line item amounts in question.

1. Provide one copy of data with cover letter for each copy of Application. Show Application number with date and line item by number with description.

1.3 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by University's Representative and paid for by University.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Refer to General Conditions Article 9, paragraph 9.3.

C. Payment Application Forms: Use forms provided by University for Applications for Payment. Sample copies are included with the exhibits.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Design Builder. University's Representative will return incomplete applications without action.

1. Entries shall match data on the Cost Breakdown and Design Builder's Contract Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders issued before last day of Contract period covered by application.

E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to University's Representative by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. University reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit releases on University's standard forms, executed in a manner acceptable to University's Representative. Sample forms are provided with the exhibits.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. List of principal supplies and fabricators.
3. Cost Breakdown.
4. Design Builder's Contract Schedule (preliminary if not final).
5. Products list.
6. Schedule of unit prices.
7. Submittals Schedule (preliminary if not final).
8. List of Design Builder's staff assignments.
9. List of Design Builder's Design Professionals.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Surrounding Site Condition Survey Report and Videotape.

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for University occupancy of designated portions of the Work.
3. Administrative actions and submittals that shall proceed or coincide with this application include:

    a. Occupancy permits and similar approvals.
    b. Warranties (guarantees) and maintenance agreements.
    c. Test/adjust/balance records.
    d. Maintenance instructions.
    e. Meter readings.

f. Start-up performance reports.
g. Changeover information related to University's occupancy, use, operation and maintenance.
h. Final cleaning.
i. Application for reduction of retainage, and consent of surety.
j. Advice on shifting insurance coverage's.
k. Final progress photographs.
l. List of incomplete Work, recognized as exceptions to University's Representative's Certificate of Substantial Completion.
m. Building commissioning report, if applicable to project.

I. Final Payment Application: Refer to General Conditions Article 9, paragraph 9.8. Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Approved building commissioning and commissioning completion certificate.
3. Completion of items specified for completion after Substantial Completion.
4. Transmittal of required Project record documents to University.
5. Certified property survey.
6. Proof that taxes, fees and similar obligations have been paid.
7. Removal of temporary facilities and services.
8. Removal of surplus materials, rubbish and similar elements.
9. Change of door locks to University's access.

PART 2 - PRODUCTS (Not

Used) PART 3 - EXECUTION

(Not Used)

END OF SECTION 01 2900

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Administrative and supervisory personnel.
2. Project meetings.

    a. Preconstruction
    b. Design Progress
    c. Preinstallation
    d. Weekly Progress
    e. Shoulder to Shoulder Review Process
    f. Billing
    g. Guarantees, Bonds and Service and Maintenance Review

3. Request for Information (RFI).
4. Partnering

B. Related Sections include the following:

1. Division 01 Section “Execution” for Utility Shutdown Requirements and necessary Request Forms.
2. Division 01 Section "Construction Progress Documentation" for preparing and submitting Design Builder's Contract Schedule.
3. Division 01 Section “Coordination and Detailing Activity” for preparing CDA drawings.
4. Division 01 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
5. Division 01 Section "Closeout Procedures" for coordinating Contract closeout.

1.2 DEFINITIONS

A. RFI: Request from Design Builder seeking information, interpretation or clarification of the Contract Documents.

B. Contingency Plan: Based upon the findings identified in the Impact Analysis, a Contingency Plan may be required by the university. This plan will identify those actions necessary to mitigate and/or minimize disruptions in utility service and to maintain operational readiness during a utility shutdown. The General Contractor shall provide all necessary management, personnel and material resources needed to execute the plan at the time of the utility shutdown event, and such shall be included in this Contingency plan.

C. Contractor: As used herein, the Contractor is the Design Builder with overall responsibility for executing the scope of work necessitating the utility shutdown.

D. Impact Analysis: The Impact Analysis identifies all systems, operations, and parties that will be affected by the proposed shutdown of the utility and specifically what that impact is. It shall include sufficient field forensic investigations to verify as-built conditions and that all systems and parties affected by the shutdown have been identified. Drawings and work plans shall be developed to convey actual field conditions and affected physical areas and infrastructure of the facility. This research shall also identify the affected stakeholders and the resulting impacts to their operations. This Impact Analysis will be used by UCR to determine the need for development of a contingency plan.

E. UCR Architects and Engineers (A&E): is the authority requiring, and who is responsible for the review and approval process for all Capital Program project Utility Shutdown Requests and all construction documents provided to UCR.

F. UCR Architects and Engineers (A&E) Construction Inspector Of Record (CIOR): Is the UCR field representative directly responsible for all construction inspections, general oversight and enforcement of all code requirements and approved construction documents, including all USR's, for the construction project. He/she will be instrumental in oversight of the Utility Shutdown event and will be present during the event.

G. UCR Architects and Engineers (A&E) Project Manager (PM): Is the UCR representative directly responsible for the preparation and general oversight and coordination of the construction project, and who is involved with the overall review, scheduling and approval of the Utility Shutdown Request (USR).

H. Utility Shutdown: A utility shutdown is any disruption or disconnects of continuity (including abandonment) of any and all utility systems for any length of time. This includes, but is not limited to: electrical, water, natural gas, fuel, fire alarm, security/automatic security cameras, sewer, communications, HVAC, automatic fire sprinkler system, etc.

I. Utility Shutdown Plan (USP): The overall plan, which includes Utility Shutdown Request Form, Impact Analysis, Shutdown Calendar, and all other details relating to the shutdown of any utilities on a specific Capital Programs, Construction and Design Project. This (USP) shall be submitted and included in the Construction Documents and Project Specifications Manual for each specific project.

J. Utility Shutdown Request (USR): The USR form identifies the time and date of the proposed shutdown, the type of shutdown, specific location, work area, affected buildings/systems, point of contact for the contractor, etc. It also includes a required Impact Analysis. A check list is attached to the form to assist the contractor in addressing the impact analysis.

1.3 COORDINATION

A. Coordination: Coordinate design and construction operations included in different Sections of the Specifications to ensure efficient and orderly development and installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
5. Do not delegate responsibility for coordination to any Subcontractor.
6. Resolve differences or disputes between Subcontractors concerning coordination, interference.
7. Ensure that anchorage, blocking, joining, and other detailing are provided.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for University and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with the development of the construction documents and other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Design Builder's Contract Schedule.
2. Preparation of the Cost Breakdown.
3. Installation and removal of temporary facilities and controls.
4. Development of the construction documents.
5. Development of the CDA Drawings.
6. Construction of mockups.
7. Delivery and processing of submittals.
8. Progress meetings.
9. Preinstallation conferences.
10. Project closeout activities.
11. Startup and adjustment of systems.
12. Commissioning plan and commissioning schedule.

D. Coordination with the University:

1. Design Builder shall notify University's Representative in writing a minimum of 72 hours (except utility shutdowns or connections. See utility shutdown requirements in section 01 7300 - Execution.) in advance of any activity that will be outside the contract limits or that would interfere with the University's daily operation.
2. Observation of Work by University's Representative shall not be interpreted as relieving the Design Builder from responsibility for coordination of all Work, superintendents of the Work, or scheduling and direction of the Work.
3. Coordinate with University's Representative to assure that Work on the project site, access to and from the project site, and the general conduct of operations is maintained in a safe and efficient manner, and that disruption and inconvenience to existing streets and property is minimized.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as University's property.

1.4 SUBMITTALS

A. Key Personnel Names: At Notice to Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site unless submitted as part of Request for Proposal (RFP). Any changes from RFP require University's approval. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project Manager, Field Engineers and superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

B. Superintendent or assistant superintendent shall be present at any time work is being performed, including weekends and overtime hours.

1.6 PROJECT MEETINGS

A. The person designated to make decisions binding to and on behalf of the Design Builder, defined as Design Builder's Project Manager, will attend meetings described below. Additional meetings may be required for special consideration as determined by the University's Representative.

B. Preconstruction Conference: University's Representative will schedule a preconstruction conference and organizational meeting, before start of construction, at Project site or another convenient location.

1. Attendees: University's Representatives, Design Builder's Senior Officer, Design Builder's Project Manager, Field Engineers and superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project. Others may attend as invited by the University's Representative.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Procedures to be followed during performance of the Work.
    b. Tentative contract schedule.
    c. Phasing.
    d. Critical work sequencing and long-lead items.
    e. Designation of key personnel and their duties.
    f. Procedures for processing field decisions and Change Orders.
    g. Procedures for request for information (RFI).
    h. Procedures for testing and inspecting.
    i. Procedures for processing Applications for Payment.
    j. Distribution of the Contract Documents.
    k. Submittal procedures.
    l. LEED requirements (Sustainable design).
    m. Preparation of Record Documents.
    n. Use of the premises and if applicable, existing building(s).
    o. Work restrictions.
    p. University's occupancy requirements.
    q. Responsibility for temporary facilities and controls.
    r. Construction waste management.
    s. Parking availability.
    t. Office, work, and storage areas.
    u. Equipment deliveries and priorities.
    v. First aid.
    w. Security.
    x. Progress cleaning.
    y. Working hours.

3. Minutes: University's Representative will record and distribute meeting minutes.

C. Design Progress Meetings: University's Representative will schedule regular weekly Design Progress Meetings to determine the progress of the development of the Design portion of the Work prior to allowing construction to commence.

1. Attendees: The University Representative and University's Consultants; the Design Builder's Design Professional, the Design Builder's Senior Officer, Project Manager, Superintendent, Field Engineers, major subcontractors and others as directed by the University's Representative.
2. Agenda: Design Builder shall be responsible for developing the meeting agendas. Discuss items of significance that could affect the completion of the

Construction Drawings and Specifications and have a major impact of the quality, cost and overall schedule for the Work. Agenda shall be submitted for approval to the University's Representative a minimum of 48 hours prior to meeting.

3. Minutes: Record and distribute meeting minutes.

D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the University's Representative of scheduled meeting date a minimum of 7 days prior to meeting. Others may be invited as directed by the University's Representative.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. The Contract Documents.
    b. Options.
    c. Related request for information (RFI).
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Review of mockups.
    i. Possible conflicts.
    j. Compatibility problems.
    k. Time schedules.
    l. Weather limitations.
    m. Manufacturer's written recommendations.
    n. Warranty requirements.
    o. Compatibility of materials.
    p. Acceptability of substrates.
    q. Temporary facilities and controls.
    r. Space and access limitations.
    s. Regulations of authorities having jurisdiction.
    t. Testing and inspecting requirements.
    u. Installation procedures.
    v. Coordination with other work.
    w. Required performance results.
    x. Protection of adjacent work.
    y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

E. Construction Progress Meetings: Attend progress meetings at weekly intervals. Coordinate dates and location of meetings with the University's Representative.

1. Attendees: In addition to University Representatives, Design Builder's Project Manager and Superintendent, Design Professional and each subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work. Others may be invited as directed by the University's Representative.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Design Builder's Contract schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Design Builder's Contract Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review look ahead schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Request for information (RFI).
16) Status of Bulletins
17) Status of cost proposal requests.
18) Pending changes.
19) Status of Change Orders.

20) Pending claims and disputes.
21) Documentation of information for payment requests.
22) Closeout procedures.

3. Minutes: University's Representative will record and distribute to Design Builder the meeting minutes.
4. Reporting: Design Builder shall distribute minutes of the meeting to each party recorded as present and to parties who should have been present.

a. Schedule Updating: Revise Design Builder's Contract schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Shoulder-to-Shoulder Review Process:

1. Shall be implemented in an effort to enhance and accelerate the review and approval process of submittal documents required during the Drawing Development, Construction, and Commissioning. A U.C. Riverside representative will schedule regular Design Progress Meetings to determine the progress of the development of the Design portion of the Work. These meetings will start within two weeks of the first Notice to Proceed date. This NTP date is contingent upon project award to the Design-Builder and will occur as noted below:

a. Design to Budget Period (NTP through Basis of Design): Once a week minimum and as required to accomplish this Design to Budget effort.
b. Design Development Period (Basis of Design to 60% baseline Documents: Weekly Meetings.
c. Design Completion by Subcontractors and Construction Period: Biweekly meetings until submittal completion then as needed and as determined by U.C. Riverside.

2. Consists of multiple (more frequent) live and active workshops involving all decision makers (Design Builder, Design Professionals; Architect and Engineers of Record, Subcontractors, Specialty Contractors, Specialty Consultants, U.C. Riverside employees, consultants and peer reviewers) where real-time decisions and approvals are accomplished. The Design Builder shall be responsible for staffing Shoulder-to-Shoulder review sessions with key personnel from the appropriate design disciplines to accommodate timely approvals.
3. Throughout the process, trust, respect, and guidelines for open communication and agreement are established and maintained. This allows for a productive integrated team, positive performance outcomes, cost savings, reduction in overall design and construction schedule.
4. Goals and Objectives:

a. Integrate the entire project team:

1) Establish clear lines of communication and points of contact. Project team shall consist of, but is not limited to, Design Builder, design professionals, architect and engineers of record, subcontractors, specialty contractors, specialty consultants, U.C. Riverside representatives, and agency-employed consultants.
2) Schedule Shoulder-to-Shoulder workshops through the duration of the project (reviews may be scheduled at milestones tied to the baseline schedule – more frequent reviews may occur with larger complex packages).

    a) Meetings: To discuss significant items that could affect the completion of the Construction Drawings and Specifications or have a major impact of the quality, cost and schedule for the Work. The agenda shall be submitted to the U.C. representative a minimum of 48 hours prior to the scheduled meeting date.
    b) Agendas: The Design-Builder shall be responsible for developing and distributing the meeting agendas.
    c) Minutes: The Design-Builder will record and distribute the meeting minutes.

3) Co-locate key personnel at appropriate facilities.

b. Establish and agree on goals and objectives for a successful design:

1) Promote an environment of cooperation, teamwork, and collaboration to develop the best solutions within the limits of the project scope and budget.

c. Confirm and approve Project requirements post NTP:

1) Resolve outstanding issues concerning the Design Builder's Work.
2) Gain insight from the user(s) into what works and what doesn't (user(s), in turn, shall give meaningful feedback in a timely manner and not delay decisions).

d. Scope and Code Compliance Review:

1) U.C. representative and agency-employed consultants shall confirm or reject building systems or assemblies in a timely manner.
2) Mark up drawings, specs and/or cut sheets:

    a) Place review comments directly on the documents (comments should be made in red, legible, and understandable).
    b) Scan and upload documents onto web-based project management system to be accessed by all parties involved.

3) Identify all submittals in the submittal schedule not anticipated to be addressed in the specifications.

4) U.C. Riverside reserves the right to withhold action on any submittal that requires coordination with other submittals until all subsequent related submittals are received by the University.
U.C. Riverside's review period will not begin until all interrelated submittals are received and available for review by the University.

G. Billing Meetings: Attend a monthly meeting prior to submittal of the Application for Payment, at a location acceptable to University's Representative.

1. Attendees:

a. University's Representative
b. Design Builder's Project Manager
c. Superintendent
d. Subcontractors, as appropriate
e. Others as directed by University's Representative

2. Agenda:

a. Determination of current schedule progress.
b. Review of Work completed based on the cost loaded schedule to be billed in the Application for Payment.

3. Schedule Updating: Revise the Contract Schedule prior to the meeting based on information determined at prior progress meetings. Review schedule revisions and prepare a final revised schedule for submission with the application for payment following the meeting.

H. Guarantee to Repair Review Meetings: In accordance with the General Conditions, Article 12 and as specified herein; attend a meeting at the fourth, eighth and 11th month following the date of Substantial Completion.

1. Attendees:

a. University's Representative
b. User's Representative
c. University's Consultants as appropriate
d. Design Builder's Project Manager
e. Design Professional, as appropriate
f. Subcontractors, as appropriate
g. Others as appropriate or as directed by University's Representative

2. Agenda:

a. Review any issues with the project that might be defective work as noticed by the University Representatives.
b. Review of guarantees, bonds, service and maintenance contracts for materials and equipment that might be in effect.
c. Walk the project site to review any defective work.

1.7 REQUEST FOR INFORMATION (RFI)

A. Procedure: Immediately on discovery of any apparent conflicts, omissions, or errors, interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form provided in the exhibits.

1. RFIs shall be submitted only by the Design Builder. RFIs submitted by entities other than Design Builder will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Design Builder's work or work of subcontractors.
3. Number RFIs sequentially. Follow RFI number with sequential numerical suffix as necessary for each resubmission. For example, the first RFI would be A001.0. The second RFI would be A002.0. The first resubmittal of RFIs A001 and A002 would be A001R1 and A002R2 respectively.
4. **Limit each RFI to one subject.**

B. Submit an RFI if one of the following conditions occur:

1. Design Builder discovers an unforeseen condition or circumstance that is not described in the Contract Documents.
2. Design Builder discovers an apparent conflict or discrepancy between portions of the Contract Documents that appears to be inconsistent or is not reasonably inferred from the intent of the Contract Documents.
3. Design Builder discovers what appears to be an omission from the Contract Documents that cannot be reasonably inferred from the intent of the Contract Documents.

C. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Design Builder.
4. RFI number, numbered sequentially.
5. Specification Section number and title and related paragraphs, as appropriate.
6. Drawing number and detail references, as appropriate.
7. Field dimensions and conditions, as appropriate.
8. Design Builder's suggested solution(s). If Design Builder's solution(s) impact the Contract Time or the Contract Sum, Design Builder shall state impact in the RFI.
9. Design Builder's signature.
10. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

    a. Supplementary drawings prepared by Design Builder shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

D. Hard-Copy RFIs: Electronic copies only.

1. Identify each page of attachments with the RFI number and sequential page number.

E. Software-Generated RFIs: If allowed by the University's Representative software-generated form with substantially the same content as indicated above.

1. Attachments shall be electronic files in Adobe Acrobat PDF compatible format.

F. The following RFIs will be returned without action:

1. Requests for approval of submittals.
2. Requests for approval of substitutions.
3. Requests for coordination information already indicated in the Contract Documents.
4. Requests for adjustments in the Contract Time or the Contract Sum.
5. Requests for interpretation of University's actions on submittals.
6. Incomplete RFIs or RFIs with numerous errors.
7. Submit an RFI in a manner that suggests that specific portions of the Contract Documents are assumed to be excluded or by taking an isolated portion of the Contract Documents in part rather than whole.
8. Submit an RFI in an untimely manner without proper coordination and scheduling of Work of related trades.

G. University's action may include a request for additional information, in which case University's time for response will start again.

H. University's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Design Builder to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

1. If Design Builder believes the RFI response warrants change in the Contract Time or the Contract Sum, notify University in writing within 5 days of receipt of the RFI response.

I. On receipt of University's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify University within 5 calendar days if Design Builder disagrees with response.

J. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Design Builder.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date University's response was received.

8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

K. If Design Builder submits an RFI contrary to the above, Design Builder shall pay the cost of any review, which cost shall be deducted from the Contract Sum.

L. Design Builder shall submit request for information or clarification immediately upon discovery. Design Builder shall submit RFIs within a time frame so as not to delay the Contract Schedule while allowing the full response time described below.

1.8 RESPONSE TIME

A. University's Representative, whose decision will be final and conclusive, shall resolve such questions and issue instructions to Design Builder within a reasonable time frame. In most cases, RFIs will receive a response within 14 days. In some cases this time may need to be lengthened for complex issues, or shortened for emergencies, as mutually agreed in writing.

B. Should Design Builder proceed with the Work affected before receipt of a response from University's Representative, within the response time described above, any portion of the Work which is not done in accordance with University's Representative's interpretations, clarifications, instructions, or decisions is subject to removal or replacement and Design Builder shall be responsible for all resultant losses.

C. Failure to Agree: In the event of failure to agree as to the scope of the Contract Requirements, Design Builder shall follow procedures set forth in Article 4 of the General Conditions.

1.9 PARTNERING

A. General:

1. Definition. “Partnering” is the process by which the parties to the Contract meet and agree to the manner in which business is to be conducted beyond the requirements of the Contract.
2. Legal Status. The Partnering process shall have no legal status and Change Orders shall be submitted for any change throughout the execution of the Work. The Partnering process shall in no way modify or void the Contract, nor shall it be legally binding on either party.

B. Process: Following the Notice to Proceed, the University and the Design Builder shall meet to agree upon the schedule and process for Partnering for this project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3150 – COORDINATION AND DETAILING ACTIVITY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative provisions for the Coordination and Detailing Activity (CDA). The CDA effort will be required on the following:

1. Mechanical room floor plans.
2. Electrical room floor plans.
3. Telephone room floor plans.
4. Areas above concealed ceilings.
5. Underground utilities.
6. Exterior elevations of buildings.
7. Other spaces for equipment provided under this contract.

B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for coordination of construction issues.
2. Division 01 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 01 Section "Closeout Procedures" for coordinating Contract closeout.
4. Division 01 Section “BIM Specifications” for coordinating BIM Models.

1.2 DEFINITIONS

A. CDA: CDA is an on-site coordination program to confirm aspects of the Project's design and installation in an orderly and systematic way prior to fabrication and installation. The basis of the CDA is to assure that all utilities, architectural and structural building systems are inter-coordinated and agreed upon by University, Design Builder and subcontractors.

1.3 PERFORMANCE REQUIREMENTS

A. The provisions of this Section shall not lessen Design Builder's responsibility for providing adequate coordination for all Work including Work not indicated above.

B. Contract and/or Construction Drawings may only be diagrammatic. They are not intended to necessarily represent actual fit, tolerances, clearances, routing, or offsets required to achieve final coordination of systems or building components or to otherwise avoid conflicts between such components or systems. Design Builder shall review these documents to determine the degree of difficulty required on its part to achieve proper coordination and has allocated sufficient money and personnel (notwithstanding the minimum personnel requirements stipulated in the Contract) to accomplish the necessary coordination, fit, and routing of systems or components.

University's Representative and its' consultants are not responsible for the quality or content of Design Builder's Work.

C. The University's Representative, Design Builder's Project staff, subcontractors, and Design Professionals shall participate in this program. At the completion of the CDA, Design Builder and subcontractors are required to sign off on their acceptance. Signature shall indicate that the Work represented on the CDA drawings is constructable and has been reviewed by Design Builder, Design Builder's Design Professionals, and subcontractors and all are in concurrence with information contained on the CDA Drawings.

D. Change Order Requests during CDA: Change Order requests regarding issues being detailed and coordinated under the provisions of this Section will not be accepted by University's Representative.

1.4 SUBMITTALS

A. CDA Drawings: Prepare CDA Drawings using 3D CAD program to provide the University with maximum utilization of space, for efficient installation of different components, and for coordination of installation for products and materials. The CDA drawings shall be the shop drawing for that trade. Additional shop drawings shall not be produced after signing off CDA drawings without a complete redo of the CDA process.

1. Content: Project-specific information, drawn accurately to scale, minimum ¼"=1'-0". CDA Drawings shall not be based on reproductions of the Contract Documents or standard printed data. Reproductions and coordination with the Design Builder's Design Professional Construction Drawings may be used in preparation of the CDA drawings. Drawings shall include plans, sections, elevations or profiles in order to determine the location of equipment, products and materials in plan and height above a common reference point. Include as a minimum the following information:

   a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   b. Indicate required installation sequences, where applicable.
   c. Indicate dimensions shown on the Contract or Construction Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and the University's minimum clearance requirements. Provide alternate sketches to University's Representative for resolution of such conflicts.
   d. CDA drawings shall contain a title block in the lower right hand corner of the sheet indicating specific location and extent of Work covered and Design Builder's company name.
   e. Dimension the location of all utilities and architectural components, vertically and horizontally, to within 1/4 inch.
   f. Illustrate the correct size of equipment, materials, components, ducts, and pipes, switches, disconnects, etc. Indicate code and/or University's minimum clearance requirements, service access locations and maintenance access

as well as equipment door swings. Indicate the maintenance walkway and aisles clearance requirements.

~~2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches.~~
~~3. Number of Copies: Submit four opaque copies of each signed CDA drawing submittal. University's Representative may return one copy with comments.~~
~~4. Submit copies of equipment cut sheets with readable dimensions.~~
5. Submit electronic set of CDA drawing submittal.

1.5 MEETINGS

A. Orientation Meeting:

1. Prior to the start of the CDA, meet with University's Representative to discuss the CDA effort. The purpose of this meeting is to develop a mutual understanding of the administration of the CDA and the scope of the required submittals and Drawings. All members of Design Builder's Project staff shall attend the Orientation Meeting.
2. The purpose of the CDA is to expeditiously produce fully coordinated shop drawings showing a composite of systems, subsystems, along with architectural and structural elements of the Work prior to any fabrication.

B. CDA Meetings:

1. During the CDA meetings with University's Representative, the Design Builder and its subcontractors shall discuss and coordinate the locations of utilities and building elements, problems of fit, trade interfaces, and constructability. As a minimum, CDA meetings will be ~~biweekly~~ held as needed to maintain the CDA schedule ~~prior to the CDA finish milestone~~.
2. At the 100 percent completion meeting, all Subcontractors must sign the CDA drawings indicating their full approval and that each Subcontractor has fully coordinated its Work with the Work of other subcontractors.
3. University's Representative will review and evaluate the routings and placements of the coordinated utilities for compliance with the original design intent only.
4. University's Representative will review and confirm the University's required minimum clearances and maintenance walkways are being provided.
5. Design Builder may be required to attend additional coordination meetings as required at no additional expense to University.
~~6. Design Builder shall provide one set of prints of the most current CDA drawings at each CDA meetings for the University's Representative.~~
~~7. Design Builder shall bring the most current original CDA drawings to each CDA meetings.~~
8. Subcontractors shall bring equipment cut sheets with dimensions and maintenance clearance requirements for each piece of equipment.

C. The meetings will be facilitated by the Design Builder.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. CDA Sequence: Design Builder shall be responsible for developing a CDA flowchart for each type of program, to be approved by the University (similar to the example at the end of this Section) for a schematic of the entire CDA process as listed below.

1. Compare Construction Drawings with Field Conditions: Review the Construction Drawings and compare the Construction Drawings with the actual conditions in the field if possible.
2. Prepare Background Drawings: Prepare a 3D CAD background drawing that will become the common background for the detailing of the Work. The background shall accurately reflect wall lines and other elements of the Project including beams, columns, and any existing utilities. In addition to the wall layout of the Work, the background drawing shall include the anticipated locations of light fixtures, diffusers, grilles and access panels. Finish ceiling elevations and above ceiling structural mounts for equipment shall be accurately dimensioned and noted on the Drawings.
3. Approve Background Drawings: Upon completion, the background drawing will be reviewed by Design Builder and the University's Representative for approval. Design Builder and subcontractors shall coordinate and revise the background drawings to serve as the common background drawings for coordination.
4. Detail Duct and Gravity Flow Lines: Detail the mechanical duct work (being the largest above-ceiling utility) and gravity flow plumbing lines as the first elements to be depicted and coordinated on the approved background drawings. All Work shall be in a 3D program using a CAD based program.
5. Identify Conflicts with Proposed Building Systems: Using 3D CAD program to ~~I~~identify any conflicts associated with the proposed routing of the mechanical ductwork and the gravity flow plumbing lines, with other utilities, structural members, or other items within the space.
6. Resolve Conflicts and Re-detail as Required: Prepare a conflict list identifying each conflict and prepare a plan view and cross sectional drawings that accurately represent the nature and location of the conflicts in plan and elevation. Design Builder and subcontractors shall work with University's Representative to identify alternate acceptable routes to resolve conflicts. The Design Builder shall re-detail CDA drawings to reflect acceptable routing.
7. Use a separate 3D CAD drawing for Coordination of Electrical and Mechanical Systems on Background Drawings: Upon the completion of the HVAC and gravity flow CDA effort, the building systems provided by the electrical, plumbing, and fire sprinkler subcontractors shall be integrated with the HVAC and gravity flow lines by each respective subcontractor. Design Builder and subcontractors shall prepare an overlay CDA drawing for each system; electrical, plumbing, HVAC piping, fire sprinklers, etc. The approved background with mechanical ductwork and gravity flow plumbing system will serve as the background for these systems.
8. Identify Conflicts with Proposed Systems: Compare and identify conflicts between their proposed systems and all other systems proposed. Revise the CDA

drawing with the intent of eliminating the interference's and conflicts. In addition, review in the field any conflicts associated with any building system that affects the routing of subcontractor's systems. Work closely with University's Representative, to integrate and coordinate systems within the design intent.

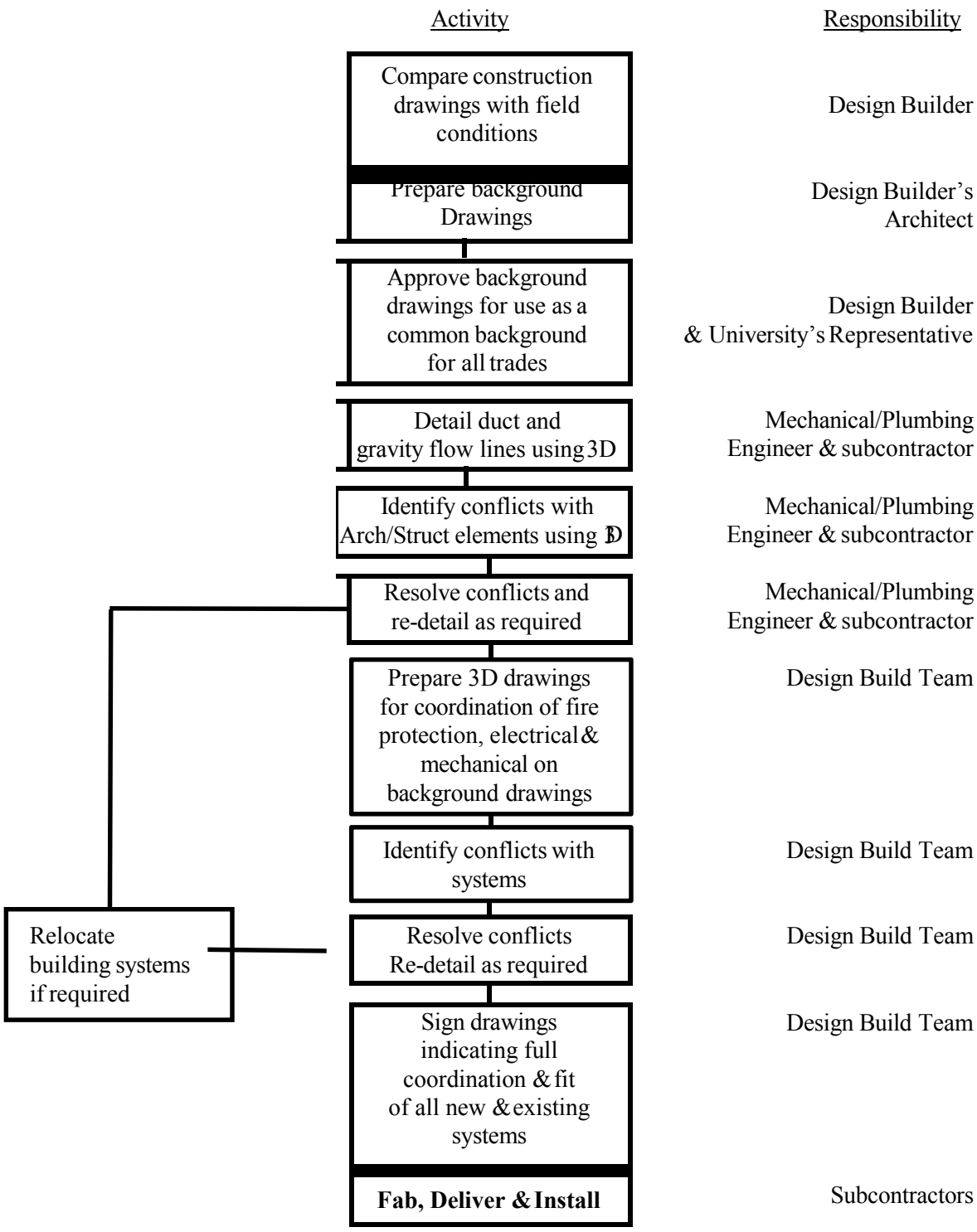
9. Resolve Conflicts and Re-detail as Required: Upon the completion of this CDA effort, develop a conflict list that shall identify all systems that are in conflict with another building system. Prepare plan view and cross sectional drawings as required to accurately identify the conflict and its exact location. Revise CDA drawings as required to avoid building systems that cannot be relocated.
10. Sign Drawings indicting full Coordination and Fit of all Building Systems: The end product of this effort shall be a fully coordinated set of drawings, consistent with the design intent and Applicable Code Requirements for the Work. Upon the completion of the CDA drawings, Design Builder and subcontractors shall indicate that they have coordinated their Work by signing the CDA drawing. Upon the execution by Design Builder and subcontractors of the CDA drawings, fabrication can proceed.

B. Conflicts shall be resolved through the CDA process rather than at the installation stage. Conflicts occurring at the installation stage will not be the basis for additional costs or time extensions.

C. ~~Coordination services~~ The Design Build team will include review of construction drawings for their completeness, constructability, and code compliance. Failure to perform this satisfactorily will not be the basis for additional compensation.

COORDINATION AND DETAILING ACTIVITY FLOWCHART

For above ceiling phase of Work, the procedure shall be as follows:



END OF SECTION 01 3150

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of the Contract Time during performance of the Work, including the following:

1. Preliminary Contract Schedule.
2. Design Builder's Contract Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.
8. Schedule Updates
9. Schedule Revisions
10. Recovery Plan
11. Look Ahead Schedule

B. Related Sections include the following:

1. Division 01 Section "Payment Procedures" for submitting the Cost Breakdown.
2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 01 Section "Photographic Documentation" for submitting construction photographs.
5. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the project. Activities included in a Contract schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the Cost Breakdown to the associated activities. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by University's Representative.

C. CPM: Critical path method, which is a method of planning and scheduling a project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration.

E. Days: As stated in General Conditions, calendar days.

F. Event: The starting or ending point of an activity.

G. Float: The measure of leeway in starting and completing an activity.

1. Float time: refer to General Conditions, Article 3, and paragraph 3.17.2.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

H. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

I. Major Area: A story of construction, a separate building, or a similar significant construction element.

J. Milestone: A key or critical point in time for reference or measurement.

K. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

L. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

M. Activity ID Structure: The design builder and/or contractor should use smart activity ID using alphanumeric numbers to identify the activity by CSI section, area/level or responsibility. The first digit of the activity ID should start with the project ID.

N. Calendar: There should be minimum of two calendars defined in the contract schedule. All of the activities except for the project milestones should be assigned with calendar – 1, unless specified by the University. Additional calendars may be added later if required by the design builder and/or contractor or the University. These are;

1. Calendar – 1: Working day schedule that includes all of the University's holidays and no work periods on weekends.
2. Calendar – 2: Seven-day calendar that includes no holidays and weekends.

1.3 SUBMITTALS

A. Qualification Data: For scheduling consultant.

B. Submittals Schedule: Submit electronic copy of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Submittal Number and Title
5. Name of subcontractor.
6. Description of the Work covered.
7. Scheduled date for University's final release or approval.
8. Total cost of invoice to be submitted for payment on delivery of each submittal item.
9. Refer Appendix-B for details of the format and data for Submittal Schedule.
10. Use latest version of Microsoft Excel software to develop the Submittal Schedule.

C. Preliminary Contract Schedule: Submit electronic copy of all required reports and plots.

1. Approval of cost-loaded preliminary Contract schedule will not constitute approval of Cost Breakdown for cost-loaded activities.
2. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.

D. Preliminary Network Diagram: Submit electronic copy, large enough to show entire network for entire Contract period. Show logic ties for activities.

E. Design Builder's Contract Schedule: Submit electronic copy of all required reports and plots.

1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.

F. CPM Reports: Concurrent with CPM schedule, submit electronic copy of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Total Float Report: List of all activities sorted in ascending order of total float, and then early start/early finish date.
2. Earnings Report: Compilation of Design builder and/or contractor's total earnings from Notice to Proceed until the most recent Application for Payment.
3. The Design builder and/or contractor shall submit electronic copy showing all the ongoing and remaining activities.
4. The Design builder and/or contractor shall submit any other type of report as deemed necessary by the University.
5. Plot of critical path and all activities with less than 10 days of total float in 81/2 x 11 format.

6. A filtered report of all activities that has UCR responsibility (electronic copy).

G. Processing Time: Allow enough time for review, including time for resubmittals, as follows. Time for review shall commence on University's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. At a date specified in the Contract Documents, the Preliminary Contract Schedule shall be submitted in response to the University's Request for Proposals as a Technical Submittal.
2. During the Technical Submittal evaluation period the University will review the Preliminary Contract Schedule.
3. Within 14 days after the issuance of the Notice to Proceed, the Design builder and/or contractor shall incorporate the University's comments and resubmit the fully cost- and resource-loaded Preliminary Contract Schedule.
4. Within 7 days after receipt of the revised Preliminary Contract Schedule, the University's Representative will reject or accept the Preliminary Contract Schedule. The Preliminary Contract Schedule will then be used to monitor the Work until the University's approval of the Contract Schedule. In case of rejection, Design builder and/or contractor must revise and resubmit the Preliminary Contract Schedule until accepted.
5. The Design builder and/or contractor will use the Preliminary Contract Schedule as the basis for preparing the Contract Schedule. The Design builder and/or contractor will submit the Contract Schedule to the University's Representative within 40 days of the date that the Preliminary Contract Schedule is approved. University's Representative will determine acceptability of the Contract Schedule within 14 days after its receipt.
6. In case of rejection, the Design builder and/or contractor must revise and resubmit the Contract Schedule within 7 days.
7. University's Representative will re-review and determine acceptability of the revised Contract Schedule within 7 days after its receipt.
8. Once approved by the University, the Contract Schedule will be used to monitor the Work.

H. Daily Construction Reports: Submit electronic copy at weekly intervals.

I. Material Location Reports: Submit electronic copy at weekly intervals.

J. Field Condition Reports: Submit electronic copy at time of discovery of differing conditions.

K. Special Reports: Submit electronic copy at time of unusual event.

1.4 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: The Design builder and/or contractor's team shall include an experienced specialist in CPM scheduling and reporting acceptable to the University, with the capability of producing CPM reports and diagrams within 48 hours of University Representative's request. Submit information to demonstrate the capabilities and experience of the selected consultant including:

1. Background information on the selected firm.
2. Descriptions of completed and current projects that are similar in scope, size, and complexity.
3. References listing project names and addresses, and contact information for clients and owners.
4. Resumes of the consulting firm's principals and the professionals who will be assigned to the project.

B. Other information, as requested. Prescheduling Conference: Conduct conference at Project site within two weeks of NTP to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Contract Schedule and Design Builder's Contract Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, such as phasing, work stages, area separations, interim milestones and partial University occupancy.
4. Review delivery dates for University-furnished products.
5. Review schedule for work of University's separate contracts.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for completion and startup procedures.
9. Review and finalize list of Contract activities to be included in schedule.
10. Review submittal requirements and procedures.
11. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of Contract activities and with scheduling and reporting of separate contractors.

B. Coordinate Design Builder's Contract Schedule with the Cost Breakdown, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Develop a Submittals Schedule arranged in chronological order by the dates shown in the Contract Schedule. Include time required for review, re-submittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Cost Breakdown, and Design Builder and/or contractor's Contract Schedule. Refer Appendix-B for details of the format and data for Submittal Schedule.
2. Use latest version of Microsoft Excel software to develop the Submittal Schedule.
3. Initial Submittal: Submit concurrently with preliminary contract schedule. Include submittals required during the first 90 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

2.2 DESIGN BUILDER'S CONTRACT SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. The minimum number of activities and their description shall correspond to the Cost Breakdown. Comply with the following:

1. Activity Duration: Define activities so no construction activity is longer than 14 days, unless specifically allowed by University's Representative.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 3300, Submittal Procedures, in schedule. Coordinate submittal review times in Design builder and/or contractor's Contract Schedule with Submittals Schedule. Phase the submittal process to ensure that items are submitted in order of their importance to the construction process. Implement a system that staggers submittals by "start no earlier than" date in a number of waves.
4. Startup and Testing Time: Include sufficient/minimum of 30 day time to comply with the requirements of the relevant sections of this specification, Execution Requirements, General Commissioning Requirements; and any regulatory requirements; and assure completion of the Work within the Contract Time.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for University's administrative procedures necessary for certification of Substantial Completion.

C. Other Requirements: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.

2. Work under More Than One Contract: Include a separate activity for each contract. Include milestones with a finish no later than constraints, for all of the scope of work done by others that is anticipated to impact under your contract.
3. Work by University: Include a separate activity for each portion of the Work performed by University. Coordinate with the University's Representative and separate contractors and others as required to assure completion of the Work within the Contract Time.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 1000- Summary. Delivery dates indicated stipulate the earliest possible delivery date.
5. University-Furnished Products: Include a separate activity for each product. Design builder and/or contractor shall include the latest date that University-furnished products are required to allow completion of the Work on schedule.
6. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Agency Reviews.
    e. Beneficial occupancy before Substantial Completion.
    f. Use of premises restrictions.
    g. Provisions for future construction.
    h. Seasonal variations.
    i. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Design Package(s)
    b. CDA Drawing(s)
    c. Submittals.
    d. Agency Reviews.
    e. Demolition.
    f. Purchases.
    g. Mockups.
    h. Fabrication.
    i. Sample testing.
    j. Deliveries.
    k. Installation/Construction
    l. Tests and inspections.
    m. Adjusting.
    n. Curing.
    o. Startup and placement into final use and operation.
    p. Punch List.
    q. Closeout stages 1 thru 5 (refer section 01 7700)
    r. Training
    s. Occupancy.

8. Area/ Level Separations: Identify each major area of construction for each major portion of the Work. Indicate how each construction activity within a major area

must be sequenced or integrated with other construction activities to assure completion of items including, but not limited to, the following:

a. Demolition.
b. Structural completion
c. Permanent space enclosure.
d. Plumbing installation.
e. Fire protection installation.
f. HVAC installation.
g. Electrical installation
h. Hardscape, Landscape.
i. Substantial Completion.

D. Milestones: Show milestones in the schedule including, but not limited to, substantial completion, completion of each stage of the work and for work done by others.

E. Cost Loading: Refer to Section 01 2900, Payment Procedures, for cost reporting and payment procedures.

1. Each activity cost shall reflect an accurate value subject to approval by University's Representative.
2. Total cost assigned to activities shall equal the total Contract Sum.

F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change, if any, on the overall project schedule and Contract Time

G. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

1. Primavera Project Planner®, latest version, for Microsoft® Windows operating system.

2.3 PRELIMINARY CONTRACT SCHEDULE

A. Preparation: Indicate each significant Contract activity separately. Outline Project activities in detail through the approval of the Construction Drawings and receipt of permits. Activities to be included in the Preliminary Schedule will be as follows:

1. Detailed Submittal, review, and procurement activities including all submittals for the Work.
2. Detailed activities for CD Design thru University approval for individual design packages.
3. Construction activities for the first 90 calendar days (Three months).
4. Summarize activities for the remainder of the Work. The remainder of the Work will include, but shall not be limited to, the following activities in reasonable detail, indicating the probable critical path:

a. Remaining Foundation and structure activities
b. Skin and interior finishing activities

c. MEP rough-in and finish activities.
d. Interior finish activities
e. Critical lead times
f. Commissioning and move-in activities
g. Final site work activities

5. The Preliminary Contract Schedule shall be a feasible, workable and reasonable schedule for the first 90 calendar days (three months) of Work, and will serve as the basis for development of the accepted Design builder and/or Contractor's Contract Schedule.

B. Submittal: The Preliminary Contract Schedule shall be submitted as a Technical Submittal in response to the University's Request for Proposals.

C. Review and Approval: Upon Notice to Proceed, the University shall provide comments and suggested revisions to the selected Design builder and/or contractor. Within 14 days of the date established in the Notice to Proceed, the Design builder and/or contractor shall incorporate the University's comments and submit a revised Preliminary Contract Schedule including a weekly workforce projection and monthly cash-flow analysis. The University's Representative will accept or reject the Preliminary Contract Schedule within 7 days after receipt of the revised Preliminary Contract Schedule. In case of rejection, Design builder and/or contractor must revise and resubmit the Preliminary Contract Schedule until accepted.

2.4 DESIGN BUILDER'S CONTRACT SCHEDULE (CPM SCHEDULE)

A. The Design builder and/or contractor will use the Preliminary Contract Schedule as the basis for preparing the Contract Schedule. The Design builder and/or contractor will submit the Contract Schedule to the University's Representative within 40 days of the date that the Preliminary Contract Schedule is approved. Activities shown at the summary level in the Preliminary Contract Schedule shall be detailed in the Contract Schedule. Include weekly workforce projections and monthly cash flow analysis for the duration of the Work based on indicated activities.

B. Submit a detailed submittal schedule for the entire job with the Contract Schedule submittal.

C. CPM Schedule: Prepare Design builder and/or contractor's Contract Schedule using a computerized, cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Failure to include any work item required for performance of this Contract on the CPM Schedule shall not excuse Design builder and/or contractor from completing all work within applicable completion dates, regardless of University's approval of the schedule.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.

3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates. Refer Appendix-A for details of schedule update and pay application procedure.
4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
5. Inclement Weather: The Supplementary Conditions indicate the number of days the Design builder and/or contractor should build into the Contract Schedule for inclement weather. Within the Contract Time, include the stipulated days for "Excusable Delay" due to inclement weather conditions.

    a. Include the allowed number of inclement weather days directly before the Notice of Substantial Completion milestone in each Contract Schedule. As the number of approved inclement weather days increases, the duration of this activity will decrease the corresponding number of days.
    b. The inclement weather activity shall be on the critical path, and there shall not be any parallel activity.
    c. Excusable delays shall be first deducted from the allowance of excusable delays shown on the Contract Schedule. When the total number of days for excusable delays due to inclement weather exceeds the number of days stipulated in the Supplementary Conditions, an extension of the Contract Time may be made by Change Order in accordance with the provisions of the General and Supplementary Conditions and Section 01 2600, Contract Modification Procedures. Extension of the Contract Time due to inclement weather will be granted only for excusable delay in excess of the number of days indicated in the Supplementary Conditions under "modification of article 8, contract time."
    d. If the Design builder and/or contractor fails to submit claim and documentation within the stipulated time, the inclement weather shall be construed to cause no delay in the construction.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Show dependencies and logic between activities so that the effect of progress (or lack of progress) on related activities and the overall schedule can be monitored. The list of activities shall include, but not be limited to, the following:

    a. Preparation and review of Design submittals and other critical design completion dates.
    b. Preparation of CDA drawings.
    c. Submittal/acceptance by the State Fire Marshal.
    d. Preparation, review and processing of Construction submittals.
    e. Significant construction milestones (e.g., completion of demo, groundbreaking, steel top-out etc.).
    f. Mobilization and demobilization.
    g. Date of request of designated working spaces, storage areas, access, and other facilities to be furnished by the University.

h. Date for decision from University's Representative on designated items or orders.
i. Underground utility site work completion.
j. Foundation completion.
k. Frame completion.
l. Shell completion.
m. Equipment requirements

1) The latest date that installation details must be provided to the Design builder and/or contractor to avoid schedule delays.
2) The latest delivery dates that will allow the project to be completed according to schedule.

n. Utility interruptions, relocation, and connections
o. Connecting to or penetrating existing structures
p. Punch list preparation/preparation
q. Work by University/ and or by other contractors that may affect or be affected by Design builder and/or contractor's activities.
r. Testing and commissioning.
s. All regulatory agency approvals (e.g., Fire Marshal, others)
t. Building move-in

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time- scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

E. Monthly Schedule Update: Prepare and submit an updated Contract Schedule to the University's Representative once each month. The updated Contract Schedule shall show the following:

1. Design builder and/or contractor's estimated percentage complete for each activity in progress (Pencil Copy).
2. Actual start/finish dates for all activities shown on initial Contract Schedule with all subsequent approved additions.
3. List of materials and/or equipment delivered for which Design builder and/or contractor is requesting payment and original invoice verifying cost.
4. Once the percentage completion of each activity in progress is assigned with an accurate actual start and/or finish date, the design/builder and/or contractor should meet with University's Representative to finalize the status of activities (Pencil Copy meeting).
5. Identification of processing errors, if any, on the previous update reports.
6. A narrative report with the updated progress analysis, which shall include, but not be limited to, a description of problem areas, current and anticipated delaying factors and their impacts, an explanation of corrective action taken, and any proposed revisions for a recovery plan (see below).

7. The updated Contract Schedule shall accurately represent the as-built condition of all completed Work and the percentage remaining of all in-progress Work activities as of the date of the updated Contract Schedule.
8. The updated Contracted Schedule shall incorporate the only changes mutually agreed upon by Design builder and/or contractor and University during preceding periodic reviews. All changes resulting from Change Orders, Field Orders and all changes including but not limited to the delays, inclement weather, work sequence changes, out of sequence etc, must be submitted at the monthly schedule logic revisions meeting (See below).
9. Following the pencil copy meeting, the design builder and/or contractor shall submit the updated Contract Schedule (File – A) at least 7 days prior to submitting the Application for Payment, in a form acceptable to the University's Representative.
10. University's Representative will determine the acceptability of the updated Contract Schedule within 7 days after its receipt.
11. No Application for Payment will be processed, nor shall any progress payments become due, until updated Contract Schedules (File – A) are accepted by the University's Representative.
12. The accepted, updated Contract Schedule shall be the Contract Schedule of record for the period it is current and shall be the basis for payment during that period.
13. Submit updated submittal schedule, along with the monthly schedule update
14. A CD ROM containing the complete Primavera Project Planner backed up data for the Contract Schedule update (File – A) and three hard copies of computer-generated reports will be furnished to the University's Representative for processing with application for payment.
15. Refer Appendix-A for details of monthly schedule update and pay application process.

F. Schedule Revisions (File – B): At the monthly Contract Schedule Revisions meeting following the University's acceptance of the monthly updated schedule, the Design builder and/or contractor shall submit any proposed schedule revisions to the University's Representative, including, but not limited to, the following:

1. Revision, if any, to assumed activity durations including revisions due to inclement weather or regulatory agency review delays.
2. Fragnet of all proposed Change Orders issued during the update period showing time impact.
3. Resolution of conflicts between actual Work progress and schedule logic when out-of-sequence activities develop because of actual construction progress. Design builder and/or contractor shall submit revisions to schedule logic to conform to current job status and directions, without changing original activity identification.
4. A narrative report with the updated progress analysis, which shall include, but shall not be limited to, a description of problem areas, current and anticipated delaying factors and their impacts, and explanations of corrective action taken and any proposed revisions for a Recovery Plan (see below).
5. A CD ROM containing the complete Primavera Project Planner backed up data for the Revised Contract Schedule update (File-B).
6. Within 7 days after their receipt, the University's Representative will review the proposed schedule revisions and provide comments, suggested changes, and

revisions that must be addressed by the Design builder and/or contractor to the satisfaction of the University's Representative.

7. Upon acceptance by the University's Representative, schedule revisions submitted by the Design builder and/or contractor shall be incorporated into the Contract Schedule in the next monthly update.

G. Earning Reports: Prepare Earnings Reports along with Applications for Payment as follows:

1. All Activities Report

   a. Show all activities sorted and grouped by various areas/stages and then the Cost Breakdown.
   b. For each activity show the Activity ID, description, budgeted cost, percent completed as of the last update, percent completed to-date, cost as of the previous period, cost this period, and cost-to-date.

2. Summary Activities Report

   a. Show summary activities summarized by the Cost Breakdown.
   b. The summary activities report shall show Activity ID, description, budgeted cost, percent completed as of the last update, percent completed to-date, cost as of the previous period, cost this period, and cost-to-date.

H. Recovery Plan: If any stage of Work is more than 14 days behind schedule, based on an updated Contract Schedule that incorporates any approved time extensions, The Design builder and/or contractor shall submit a Recovery Plan to the University's Representative within 5 days. The Recovery Plan shall propose revisions to the Contract Schedule for the next 60-day period to show how the Design builder and/or contractor intends to bring the Work back on schedule. The Recovery Plan shall also include a written description of how the measures that the Design builder and/or contractor intends to take to regain schedule compliance will be accomplished without additional cost to the University. Recovery Plan activities shall be identified according to their relationship to activities on the Contract Schedule.

1. Should the Design builder and/or contractor fail to submit and execute such Recovery Plan, the University shall have the option to direct Design builder and/or contractor to employ any or all measures necessary to regain schedule compliance, without additional cost to the University.
2. Upon acceptance by the University's Representative, the Recovery Plan shall be incorporated into the Contract Schedule during the next update.
3. Submit a Recovery Plan for each update that indicates that Work progress is more than 14 days behind schedule.
4. Should the Design builder and/or contractor dispute the University's Representative determination regarding the status of contract delay, such dispute shall not relieve Design builder and/or contractor of the responsibility to comply with the requirements of this Section and other related Sections until the dispute is resolved according to the Contract terms.

I. Look Ahead Schedule: On a weekly basis, prepare a detailed 2-week Look-Ahead Schedule that projects Work to be performed during the 2 weeks immediately following

the weekly construction progress meeting. The Design Builder and/or contractor shall submit the 2-week look-ahead schedules broken down separately into Design Packages, CDA activities, Submittals and the construction activities. This will enable the University to track the progress of all these units independently.

1. Look Ahead Schedule shall cover a 21-day period, beginning with the week preceding the 2-week detailed look ahead.
2. Use the Contract Schedule as the basis for generating the 2-week detailed schedule.
3. Submit copies of the 2-week detailed schedule as required at the weekly construction progress meeting.
4. Format:

    a. Provide bar chart using same logic as Contract Schedule, with maximum 14-day construction activity duration. Provide activity identification used on the accepted Contract Schedule.
    b. Provide daily resource allocation for each trade.
    c. Provide exact activity location for scheduled Work.

5. Provide information for each significant activity, with special care taken to describe scheduling and coordination with other contracts, Work by the University, utility shutdowns, road closures, etc.
6. Show the status of all outstanding and pending submittals including scheduled and actual submittal review dates and expiration of submittal review periods for preparation, GC and AE of record reviews, UCR reviews etc.

2.5 ADJUSTMENT OF TIMES FOR COMPLETION

A. In addition to provisions of the General Conditions, Articles 7 and 8, the time for completion of the Work will be adjusted in accordance with these procedures.

B. Any request for an adjustment of the Contract Time for completion submitted by Contractor for changes or alleged delays shall be accompanied by a complete Time Impact Analysis, which shall be submitted for review with the request by Contractor. Time extensions will not be granted unless substantiated by the Contract Schedule, and then not until the CPM Project float time becomes zero.

C. Each Time Impact Analysis shall provide information justifying the request and stating the extent of the adjustment requested for each specific change or alleged delay. Each Time Impact Analysis shall be in form and content acceptable to University's Representative, and shall include, but not be limited to, the following:

1. A fragmentary CPM type network (Fragnet) illustrating how Contractor proposes to incorporate the change or alleged delay into the current updated Project Schedule.
2. A CD ROM containing the complete Primavera Project Planner backed up data for the impacted Schedule update, which has the impacted added activities (fragnet).

3. Identification of activities in the current updated Project Schedule which is proposed to be amended due to the change or alleged delay, together with engineering estimates and other appropriate data justifying the proposal.
4. The Time Impact Analysis shall be determined on the basis of the date or dates when the change or changes were issued, or the date or dates when the alleged delay or delays began. The status of the construction project and Time Impact Analysis shall include event time computations for all affected activities.
5. Time Impact Analyses shall be provided for each time extension request in order to demonstrate the time impact upon the overall Project and the time for completion.

D. If, after review of the Time Impact Analysis, the University's Representative finds that Design Builder and/or contractor is entitled to any time extension, the Contract Time will be adjusted accordingly by Change Order, and the Design builder and/or contractor shall then revise the Contract Schedule accordingly.

E. The Contract Schedule will be used in the calculation of liquidated damages or Compensable delay for each day of delay after the Contract completion date, as adjusted, until the Work is accepted.

F. When Contractor is behind schedule by more than 14 calendar days beyond adjusted Contract completion date(s) after incorporating all approved time extensions, a recovery plan shall be submitted (refer to Recover Plan).

G. When the University's Representative initiates changes by proposed change order which have the potential to impact stipulated Contract completion dates for each phase, a network window shall be prepared by Contractor to reflect the impact of said changes. After network window has been mutually agreed upon, and Contractor is authorized to proceed with proposed change order, it will be incorporated into Contract Schedule. Time extensions for contracts will be considered only to the extent that there is insufficient remaining float to absorb these changes.

2.6 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries
6. High and low temperatures and general weather conditions.

    a. Rainfall, if any
    b. Total number of inclement weather days to date

7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).

10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial Completions and occupancies.
18. Substantial Completions authorized.
19. Results of construction monitoring activities including, at a minimum:

    a. Noise control
    b. Dust control
    c. Infection control if required

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Include a detailed description of the differing conditions, together with recommendations for changing or proposed changes to the Construction Documents.

2.7 SPECIAL REPORTS

A. General: Submit special reports directly to University within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, and response by Design Builder's personnel, evaluation of results or effects, and similar pertinent information. Advise University in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 DESIGN BUILDER'S CONTRACT SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.

1. In-House Option: University may waive the requirement to retain a consultant if Design Builder and/or Contractor employ skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications (refer to 1.4.A).
2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Design Builder's Contract Schedule Updating: At monthly intervals, the Design- Builder should update the contract schedule as follows:

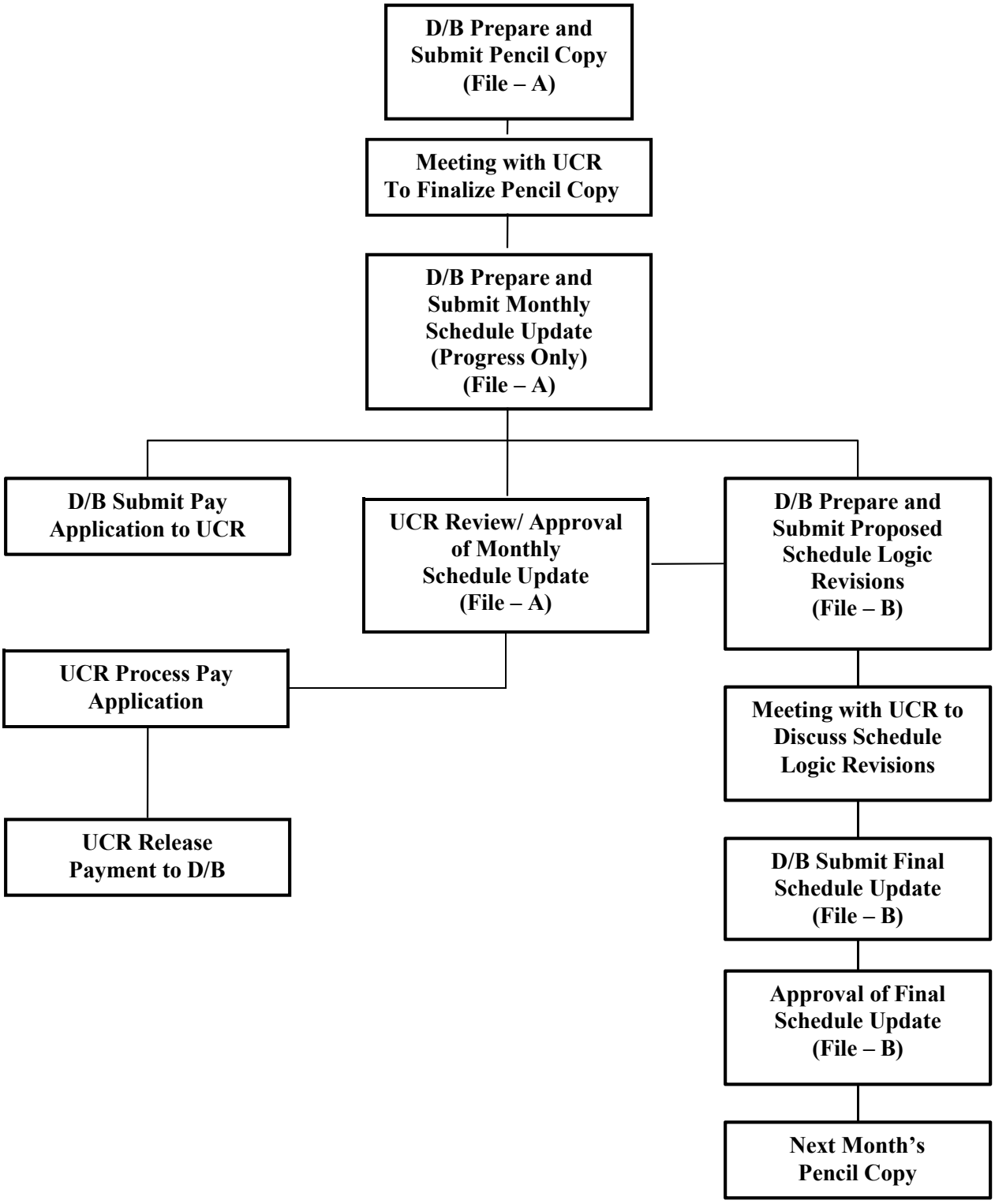
1. Pencil Copy: At the end of each month, the Design-Builder should update the schedule update with the actual progress percentage of activities, started, in progress and/or completed during the proceeding month. After the submittal of the proposed progress pencil copy schedule, Design-Builder should meet with the University's representative, to finalize the proposed progress pencil copy schedule.
2. Monthly Schedule Update (Progress Only) – (File-A): After receiving the agreed upon progress pencil copy from the University, the Design-Builder should update the monthly schedule, and submit to University for review along with the required reports as mentioned in the section 2.5 under "Design Builder's Contract Schedule.
3. Pay Application: Based upon the progress made during the proceeding month, the Design Builder should prepare and submit the Pay Application to the University.
4. Schedule Logic Revisions (File-B): After submitting the Monthly Schedule Update (Progress only) and Pay Application, the Design Builder should prepare and submit the proposed schedule logic revisions.
5. Schedule Logic Revision Meeting: Within a week of the proposed Schedule logic revisions submittal, the Design Builder should meet with the University's Representative, to discuss, and finalize the proposed schedule logic revisions.
6. Record Contract Schedule Update (File-B): The design Builder should incorporate all of the proposed schedule logic revisions as discussed in the logic revision meeting with University's Representative, and submit that schedule as final Record Schedule Update for that month. This Schedule update should be used for all issues related to any time impact analysis during that month.
7. Refer Appendix-A for details of the monthly schedule update and pay application process.

C. Distribution: Distribute copies of approved schedule to University's Representative, Design Professionals, separate contractors, testing and inspecting agencies, and other parties identified by Design Builder with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

Appendix – A

Reference:
01 3200 – 3.1.B
01 3200 – 2.5.C-3



Appendix – B

SUBM #	CPM PACKAGE	DESIGN/ CONSTRUCTION SUBMITTAL	SPEC. SECTION	SUBMITTAL CATEGORY	DESCRIPTION	RESP.	SUBMITTAL DATES										SUBMITTAL STATUS
							REQ'D DATE FROM SUB	DATE RECEIVED FROM SUB	DATE SUBMITTED TO A/E	DATE RETURNED FROM A/E	DELTA	REQ'D DATE TO UCR	ACTUAL SUBMITTED DATE TO UCR	DELTA	DATE RETURNED FROM UCR	DELTA	

CPM PACKAGE: Multiple submittals could represent one CPM activity in the Contract Schedule

SUBMITTAL CATEGORY: Shop drawing samples, calculations, etc.

SUBMITTAL STATUS:

RFC Reviewed For Conformance
NET No Exceptions Taken
MCN Make Corrections Noted
FRO For Record Only
REJ Rejected
R&R Revise and Resubmit

Reference: 01 3200-1.3 B-9
01 3200-2.1 A-1

END OF SECTION 01 3200

SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Periodic construction photographs.
2. Preconstruction video.

B. Related Sections include the following:

1. Division 01 Section "Submittal Procedures" for submitting photographic documentation.
2. Division 01 Section "Closeout Procedures" for submitting photographic negatives or digital media as Project Record Documents at Project closeout.
3. Division 02 Section "Structure Demolition" for photographic documentation before building demolition operations commence.
4. Division 02 Section "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.

1.2 SUBMITTALS

A. Install one video camera on adjacent MS&E building to record construction progress. Provide access to imagery via live web-feed. Use vantage point necessary to capture entire project building. Coordinate location and access to video-feed with University Representative.

B. Key Plan: Submit key plan of Project site and building with vantage points numerically marked and indicating direction of each.

C. Periodic Construction Photographs: Submit with each pay request photos taken within 3 days prior to submittal.

1. Format: Filename shall be in the following format:

a. ss-vv-ddmmyy.TIFF

1) s = set #
2) v = vantage point #
3) d = day
4) m = month
5) y = year

2. Digital Images: Submit a complete set of digital image electronic files as a Project Record Document on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

D. Preconstruction Video: Submit one copy on DVD-R within one week of Notice to Proceed for Phase 3.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project and University's Project Number.
b. Name of Design Builder.
c. Date video was recorded.
d. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction shall be recorded on video.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.

B. Video Format: Provide in VCD, AVI, MOV, WMV or MPEG format on DVD-R±.

PART 3 - EXECUTION

3.1 PERIODIC CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date: Include date in filename for each image.
2. Date Stamp: If possible, date and time stamp each photograph as it is being taken so stamp is integral to image.
3. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to University's Representative.

C. Periodic Construction Photographs: Take 12 digital photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Use same vantage points to show status of construction and progress since last photographs were taken.

3.2 PRECONSTRUCTION VIDEO

A. Preconstruction Video: Before starting construction, record video of Project site and surrounding properties from different vantage points, as directed by University's Representative.

1. Flag construction limits before recording construction video.
2. Show existing conditions within 100 feet of Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
4. Show protection efforts by Design Builder.

B. Narration: Describe scenes on video by audio narration by microphone while video is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
2. Begin video with name of Project, Design Builder's name, videographer's name, and Project location.

END OF SECTION 01 3233

SECTION 01 3250 – WEB-BASED CONSTRUCTION MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The University and Design Builder shall utilize a Web-based building project management system for electronic submittal of all data and documents (unless specified otherwise by the University's Representative) throughout the duration of the Contract. The Design Builder will provide access to project documents on the system to the University and all members of the Design Build team. The joint use of this system is to facilitate electronic exchange of information, key processes, and overall management of the contract. The system shall be the primary means of project information submission and management. When required by the University's Representative, paper documents will also be provided (e.g., the signature of Contract Modifications and submission of Contract Claims). In the event of discrepancy between the electronic version and paper documents, the paper documents will govern.

B. The Design Builder's system shall provide a central online location for up-to-date project information that is accessible anytime to any team member who needs it. By allowing clients and contractors to share information online, the system will speed the exchange of documents, reduces revision cycles, and simplifies asset tracking and approvals. The system helps track all the key issues to identify and mitigate risk.

1.2 USER ACCESS LIMITATIONS

A. The Design Builder will control access to project information by assigning user profiles that define levels of access into the system; determine assigned function-based authorizations (determines what can be seen) and user privileges (determines what they can do). Entry of information exchanged and transferred between the Design Builder and its Designer of Record, subcontractors and suppliers on the system shall be the responsibility of the Design Builder.

B. Joint Ownership of Data

1. Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the system) by the University and the Design Builder will be jointly owned.

1.3 AUTOMATED SYSTEM NOTIFICATION AND AUDIT LOG TRACKING

A. Review comments made (or lack thereof) by the University on Design Builder submitted documentation shall not relieve the Design Builder from compliance with requirements of the Contract Documents. The Design Builder is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents. University acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Design Builder's submitted information.

1.4 SUBMITTALS

A. University Representative's approval is required for most submittals except submittals for information only. The following shall be submitted in accordance with Section 01 3300, "Submittal Procedures":

1. Preconstruction Submittals

a. List of Design Builder's key personnel.
b. Include descriptions of key personnel roles and responsibilities for this project.

1.5 DESIGN BUILDER RESPONSIBILITY

A. The Design Builder shall be responsible for the validity of the information it places in the system and for the abilities of their personnel. Accepted users shall be knowledgeable in the use of computers, including Internet Explorer, e-mail programs such as Outlook, word processing programs such as Word, spreadsheet programs such as Excel, and Adobe Portable Document Format (PDF) document distribution program. The Design Builder will provide training of Design Build team members including University, Design Builder, design firm, subcontractor, and engineering and consultant personnel in the use of the system as needed. All costs associated with the use of this system, except for initial training, will be evenly distributed in the project overhead and spread across the duration of the contract; a separate cost line item will not be allowed.

1. User Access Administration

a. The University's Representative will provide a list of its key project personnel to the Design Builder. Design Builder will collect similar information from each of firm participating on the Design Build team. The Design Builder will update the list of project participants with system access on a regular basis and add or remove system users as necessary.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SYSTEM UTILIZATION

A. The system shall be utilized in connection with submittal preparation and information management required by Section 01 3200 "Construction Progress Documentation", Section 01 3300, "Submittal Procedures", Section 01 4000 "Quality Requirements" and other Division 1 sections. Requirements of this section are in addition to requirements of all other sections of the specifications.

1. Design Document Submittals

a. Provide all design drawings and specifications in file formats specified in other sections of the contract documents.

2. Shop Drawings

a. Shop drawing and design data documents shall be submitted as PDF attachments. All PDF shop drawing submittal documents shall have the Design Builder's review and submittal stamp (including signatures) as specified in Section 01 3300, "Submittal Procedures" the same as if submitted as hard copy. Examples of shop drawings include, but are not limited to:

1) Standard manufacturer installation drawings.
2) Drawings prepared to illustrate portions of the work designed or developed by the Design Builder.
3) Steel fabrication, piece, and erection drawings.

3. Product Data

a. Product catalog data and manufacturers instructions shall be submitted as PDF attachments to the submittal workflow process and form, except that color charts and similar color oriented pages shall be submitted as hard copy separate from and in addition to the PDF copy. Submittal forms shall indicate when hard copy color documents are submitted. All PDF product data submittal documents shall have the Design Builder’s review and submittal stamp (including signatures) as specified in Section 01 3300, "Submittal Procedures" the same as if submitted as hard copy. Examples of product data include, but are not limited to:

1) Manufacturer's printed literature.
2) Preprinted product specification data and installation instructions.

4. Samples

a. Sample submittals shall be physically submitted as specified in Section 01 3300, "Submittal Procedures". Design Builder shall enter submittal data information into the system with a copy of the transmittal form(s) attached to the submittal. Examples of samples include, but are not limited to:

1) Product finishes and color selection samples.
2) Product finishes and color verification samples.
3) Finish/color boards.
4) Physical samples of materials.

5. Administrative Submittals

a. All correspondence and Preconstruction submittals shall be submitted using the system. Examples of administrative submittals include, but are not limited to:

1) Digging permits and notices for excavation.
2) List of personnel accessing the system.
3) List of contact personnel.
4) Notices for roadway interruption, work outside regular hours, and utility cutovers.
5) Request for Information (RFI).
6) Construction Schedules and associated reports and updates.
7) Each schedule submittal specified in Specification Section 01 3200 shall be submitted as a native backed-up file of the scheduling program being used. The schedule will also be posted as a PDF file in the format specified in Specification Section 01 3200. Due to data transfer rates, do not display relationship lines in the graphical depiction of the schedule.
8) Submittal Register: Design Builder shall submit a submittal register with input data for dates for submission and upon acceptance of the register, load the register up to the system and update as required by the Contract documents.
9) Plans for safety, demolition, environmental protection, and similar activities.
10) Quality Control Plan(s), Testing Plan and Log, Quality Control Reports, Production Reports, Quality Control Specialist Reports, Preparatory Phase Checklist, Initial Phase Checklist, Field Test reports, Summary reports, Rework Items List, etc.
11) Meeting minutes for Post Award Kick-off Meeting, design review meetings, quality control meetings, progress meetings, pre-installation meetings, etc.
12) Any general correspondence submitted.

6. Compliance Submittals

   a. Test report, certificate, and manufacture field report submittals shall be submitted as PDF attachments. Examples of compliance submittals include, but are not limited to:

      1) Field test reports.
      2) Quality Control certifications.
      3) Manufacturer's documentation and certifications for quality of products and materials provided.

7. Record and Closeout Submittals

   a. Operation and maintenance data and closeout submittals shall be submitted as PDF documents during the approval and review stage as specified, with actual set of documents submitted for final. Examples of record submittals include, but are not limited to:

      1) Operation and Maintenance Manuals: Final documents shall be submitted as specified.
      2) As-built Drawings: Final documents shall be submitted as specified.

3) Extra Materials, Spare Stock, etc.: Submittal forms shall indicate when actual materials are submitted.

8. Exceptions

a. Documents with legal consequences, contract modifications, contract claims, security implications, and those required by other agencies may require an additional submittal as original hard copy with original signatures and seals. Hard copies of these documents shall be submitted as specified or as directed by the University's Representative.

END OF SECTION 01 3250

SECTION 01 3300 SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. See “Scope of Work” for Design Professionals Work and submittal process.
2. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Cost Breakdown.
3. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
4. Division 01 Section “Coordination and Detailing Activity” for submitting CDA Drawings.
5. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Design Builder's Contract Schedule and the Submittals Schedule.
6. Division 01 Section "Photographic Documentation" for submitting construction photographs and construction videotapes.
7. Division 01 Section “Product Requirements” for selection of products for submittal and product substitutions.
8. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
9. Division 01 Section "Closeout Procedures" for submitting warranties.
10. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
11. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
12. Division 01 Section "Demonstration and Training" for submitting material used for training of University's personnel.
13. Divisions 02 through 33 Sections for specific requirements for submittals in those Sections.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information that requires University's responsive action.

B. Informational Submittals: Written information that does not require University's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. University reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on University's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 4 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. University will advise Design Builder when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 2 days for review of each resubmittal.

D. Identification: Completely fill out and attach the University’s “Submittal Transmittal” form on each submittal for identification. Provide a Design Builder review sheet after the transmittal and include the following:

1. Indicate name of firm or entity that prepared each submittal on review sheet.
2. Provide a space approximately 6 by 8 inches on review sheet to record Design Builder's and Design Professional review and approval markings and action taken.
3. Include the University’s Project name and number, date and submittal number.
4. Submittal number shall be as follows,, include revision identifier on resubmittals only:

a. Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06 1000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06 1000.01.A).
b. Number and title of appropriate Specification Section.
c. Drawing number and detail references, as appropriate.

d. Location(s) where product is to be installed, as appropriate.
e. Other necessary identification.

E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

F. Additional Copies: Unless additional copies are required for final submittal, and unless University observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

G. Transmittal: Package each submittal individually by specification section and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. University will return submittals, without review, received from sources other than Design Builder. Substitutions are to be submitted separate from submittals, using the substitution request form as the transmittal.

1. Transmittal Form: Use facsimile of sample form provided with Exhibits.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "NET or MCN" by University's Representative.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.

J. Use for Construction: Use only final submittals with mark indicating "NET or MCN" by University's Representative.

K. LEED Submittals: Comply with requirements specified in Division 01 Section "Sustainable Design Requirements."

1. Submit LEED submittals in the following format:

a. PDF electronic file.

L. Material Safety Data Sheets (MSDSs) for LEED Certification: Submit information necessary to show compliance with LEED certification requirements.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Post electronic submittals as PDF electronic files directly to Web-based building project management system specifically established for Project.

a. University will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Submit electronic submittals via email as PDF electronic files.

a. University will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2.2 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections to demonstrate the way the Design Builder proposes to conform to the information given and the design concept expressed in the Contract Documents.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment per specification section.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable. Clearly indicate exact item submitted and in such a manner that reproduction by photocopying will not loose intent.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts.
e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Compliance with specified referenced standards.
k. Testing by recognized testing agency.
l. Application of testing agency labels and seals.
m. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.
5. Submit Product Data in the following format:

    a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Dimensions.
    b. Identification of products.
    c. Fabrication and installation drawings.
    d. Roughing-in and setting diagrams.
    e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    f. Shopwork manufacturing instructions.
    g. Templates and patterns.
    h. Schedules.
    i. Design calculations.
    j. Compliance with specified standards.
    k. Notation of coordination requirements.
    l. Notation of dimensions established by field measurement.
    m. Relationship to adjoining construction clearly indicated.
    n. Seal and signature of professional engineer if specified.
    o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
3. Submit Shop Drawings in the following format:

    a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as University's property, are the property of Design Builder.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit three and the number of samples the Design Builder wants returned. The University will retain three samples. Provide full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. University will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three and the number of samples the Design Builder wants returned. The University will retain three samples.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.
4. Submit product schedule in the following format:

a. PDF electronic file.

F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation".

G. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

H. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

I. Cost Breakdown: Comply with requirements specified in Division 01 Section "Payment Procedures."

2.3 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Submit in the following format:

a. PDF electronic file.

2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. CDA Drawings: Comply with requirements specified in Division 01 Section “Coordination and Detailing Activity“

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and Universities, and other information specified.

D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

K. Research/Evaluation Reports: Prepare written evidence, from ICBO Evaluation Service, Inc. unless another evaluation organization has been approved by the University's Representative, that product complies with California Building Code. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

L. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

U. Construction Photographs and Videotapes: Comply with requirements specified in Division 1 Section “Photographic Documentation."

V. Material Safety Data Sheets (MSDS’s): Submit information directly to the University’s Representative. Submit MSDS within 30 days of the associated material being delivered to the Project Site or sooner, as required by law. Material and Safety Data Sheets shall be kept on the Project Site throughout the course of the Work.

2.4 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are required after the Construction Documents are stamped

"Reviewed for Conformance", provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to University.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit one original and an electronic copy of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 DESIGN BUILDER'S REVIEW

A. Design Builder and Design Professional shall review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract and Construction Documents. Note corrections and field dimensions. Mark with approval stamps before submitting to the University's Representative.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Design Professional and Design Builder's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

C. Coordinate each submittal with requirements of the Work and of the Contract Documents. Any submittal that is not complete or not clearly identified for review will be rejected and returned to the Design Builder for re-submission.

D. Begin no fabrication or Work that requires submittals until the return of University Representative's final reviewed submittals.

3.2 UNIVERSITY'S ACTION

A. General: University will not review submittals that do not bear Design Builder's and Design Professional's approval stamp and will return them without action.

B. Action Submittals: University will review each submittal, make marks to indicate corrections or modifications required, and return it. University will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. "NET" No Exceptions Taken
2. "MCN" Make Corrections Noted

3. "REJ" Rejected
4. "R&R" Revise and Resubmit

C. Informational Submittals: University will review each submittal and will not return it, or will return it if it does not comply with requirements. University will forward each submittal to appropriate party.

D. Failure to properly and clearly mark the submittal to indicate use and options may cause submittal return without review. Submittal will be marked "Revise and Resubmit".

E. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 3300

SECTION 01 3540 – ENVIRONMENTAL MITIGATION

PART 1 – GENERAL

1.1 SUMMARY

A. The Environmental Mitigation requirement for this project is recorded in this specification Section 01 3540. The mitigations measures may include, but are not limited to, procedures and standards to control:

1. Air Quality
2. Erosion and Dust Control
3. Biological Resources
4. Cultural Resources
5. Noise Attenuation
6. Transportation and Traffic Control

B. Related Sections

1. Section 01 5000 Temporary Facilities and Controls
2. Section 01 5739 Tree Protection
3. Where Sections contain conflicting requirements the more stringent requirement shall apply. Notify University's Representative when conflicts or discrepancies are found.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:

1. Submittals shall be submitted in accordance with Section 01 3300, "Submittal Procedures."
   a. Submit Traffic Control Plan for Project Construction prior to the start of construction
   b. Submit Pedestrian Circulation Plan for Project Construction prior to the start of construction.

PART 2 - MITIGATION MEASURES

2.2 AIR QUALITY

A. Low NOx diesel fuel and construction equipment shall be used to the extent that is readily available at the time of construction.

B. The following Air Quality reduction procedures shall be implemented throughout the construction process:

1. Compliance with all SCAQMD rules and regulations.
2. Maintenance programs to assure vehicles remain in good operating condition.

3. Avoid unnecessary idling of construction vehicles and equipment.
4. Use of alternative fuel vehicles.
5. Provision of electrical power to site to eliminate the need for on-site generators.

C. Post a publicly visible sign with the telephone number and person to contact at the University regarding dust complaints, as well as the SCAQMD telephone number. This University's Representative is required to respond and direct corrective action. The Design-Builder will take directed correction action within 48 hours.

D. The Design-Builder shall prepare a construction emissions control plan that includes a comprehensive inventory of all off-road construction equipment, equal to or greater than 50 hp, that will be used for an aggregate of 40 more hours during any portion of the construction project. All contractors, and overseen by the Design-Builder, shall utilize CARB certified equipment or better for all on-site construction equipment to meet the following:

1. All off-road diesel-powered construction equipment greater than 50 hp shall meet the Tier 4 emission standards, where available. In addition, all construction equipment shall be outfitted with BACT devices certified by CARB. Any emissions control device used by the contractor shall achieve emissions reductions that are no less than what could be achieved by a Level 3 diesel emissions control strategy for a similarly sized engine as defined by CARB regulations.
2. A copy of each unit's certified specification, BACT documentation and CARB or SCAQMD operating permit shall be provided at the time of mobilization of each applicable unit or equipment.
3. Contractors are encouraged to apply for AQMD 'SOON" funds. Incentives could be provided for those construction contractors who apply for AQMD "SOON" funds. The "SOON" program provides funds to accelerate clean-up of off-road die- sel vehicles, such as heavy duty construction equipment. More information on this program can be found at the following website: http://www.aqmd.gov/tao/implementation/ soonprogram.htm

E. The Design-Builder shall also implement the following measures during construction:

1. Prohibit vehicle and engine idling in excess of 5 minutes and ensure that all off-road equipment is compliant with the California Air Resources Board's (CARB) in-use off-road diesel vehicle regulation and SCAQMD Rule 2449.
2. Configure construction parking to minimize traffic interference.
3. Provide temporary traffic controls such as a flag person, during all phases of construction to maintain smooth traffic flow.
4. Provide dedicated turn lanes for movement of construction trucks and equipment on- and off site.
5. Schedule construction activities that affect traffic flow on the arterial system to off-peak hour to the extent practicable.
6. Improve traffic flow by signal synchronization, and ensure that all vehicles and equipment will be properly tuned and maintained according to manufacturers' specifications.
7. Use diesel-powered construction vehicles and equipment that operate on low-NOx fuel where possible.

8. Reroute construction trucks away from congested streets or sensitive receptor areas.
9. Maintain and tune all vehicles and equipment according to manufacturers' specifications.

F. To minimize VOC emissions from the painting/finishing phase, for each construction project on the campus, the project contractor will implement the following VOC control measures:

1. Construct or build with materials that do not require painting, or use pre-painted construction materials.
2. If appropriate materials are not available or are cost-prohibitive, use low VOC-content materials more stringent than required under SCAQMD Rule 1113.

G. Limited parking for workers employed on the Work may be provided on the Project site to the extent that space for that purpose is available without interference with University activities or activities related to performance of the Work. For further parking requirements, refer to "Use Charges" under Section 01 5000 Temporary Facilities and Controls.

2.3 DUST CONTROL MEASURES

A. All contractors, and those overseen by the Design-Builder, shall implement dust control measures consistent with South Coast Air management District (SCAQMD) Rule 403 – Fugitive Dust during the construction phases of the project development.

1. Apply water and/or non-toxic chemical soil stabilizers according to manufacturer's specifications to all inactive construction areas (previously graded areas that have been inactive for 10 or more days).
2. Replace ground cover in disturbed areas as quickly as possible.
3. Enclose, cover, water twice daily, or apply approved chemical soil binders to exposed piles with 5 percent or greater silt content.
4. Water active grading sites at least twice daily.
5. Suspend all excavating and grading operations when wind speeds (as instantaneous gusts) exceed over 25 mile per hour over a 30-minute period.
6. All trucks hauling dirt, sand, soil, or other loose material are to be covered or should maintain at least two feet of freeboard (i.e., minimum vertical distance be- tween top of the load and top of the trailer) in accordance with section 23114 of the California Vehicle Code.
7. Sweep streets at the end of the day if visible soil material is carried over to adjacent roads.
8. Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving project site for each trip.
9. Apply water three times daily of chemical soil stabilizers according to manufacturer's specifications to all unpaved parking or staging areas or unpaved road surfaces.

B. Construction Site Speed Limit.

1. All contractors, and those overseen by the Design-Builder, shall ensure that construction site and access road speed limits be established and enforced during the construction period. Post and enforce traffic speed limits of 15 miles per hour or less on all unpaved roads.

2.4 BIOLOGICAL RESOURCES

A. Nesting Bird Surveys

1. Prior to the onset of construction activities that would result in the removal of mature trees that would occur between March and mid-August, surveys for nesting special status avian species and raptors shall be conducted on the affected portion of the campus following USFWS and/or CDFG guidelines. If no active avian nests are identified on or within 250 feet of the construction site, no further mitigation is necessary.
2. If active nests for avian species of concern or raptor nests are found within the construction footprint or a 250-foot buffer zone, exterior construction activities shall be delayed within the construction footprint and buffer zone until the young have fledged or appropriate mitigation measures responding to the specific situation have been developed and implemented in consultation with USFWS and CDFG.

B. Protection of Naturalistic Open Space

1. Unnecessary driving in sensitive or otherwise undisturbed areas shall be avoided. New roads or construction access roads would not be created where adequate access already exists.
2. Removal of native shrub or brush shall be avoided, except where necessary.
3. Drainages shall be avoided, except where required for construction. Limit activity to crossing drainages rather than using the lengths of drainage courses for access.
4. Excess fill or construction waste shall not be dumped in washes.
5. Vehicles or other equipment shall not be parked in washes or other drainages.
6. Overwatering shall be avoided in washes and other drainages.
7. Wildlife including species such as fox, coyote, snakes, etc. shall not be harassed. Harassment includes shooting, throwing rocks, etc.

2.5 CULTURAL RESOURCES

A. Protection and Recovery of Buried Artifacts

1. If a paleontological or archaeological resource is discovered during construction, all soil-disturbing work within 100 feet of the find shall cease and the University's Representative shall contact a qualified archaeologist meeting the Secretary of Interior standards within 24 hours of discovery to inspect the site. If a resource within the project area of potential effect is determined to qualify as a unique archaeological resources (as defined by CEQA), the University shall devote adequate time and funding to determine if it is feasible, through project design measures to preserve the

find intact. If it cannot be preserved the University shall retain a qualified non-University paleontologist/archaeologist to design and implement a treatment plan, prepare a report and salvage the material, as appropriate. Any important artifacts recovered during monitoring shall be cleaned, catalogued, and analyzed, with the results presented in a report of finding that meets professional standards.

a. If significant Native American cultural resources are discovered, as determined by the consulting archaeologist for which a Treatment Plan must be prepared, the Design-Builder or his archaeologist shall immediately contact the University's Representative. The University's Representative shall contact the appropriate Tribal representatives.
b. If requested by Tribal representatives, the University, the Design-Builder or his project archaeologist shall in good faith, consult on the discovery and its disposition (e.g. avoidance, preservation, return of artifacts to tribe, etc.)

2. In the event of the discovery of a burial, human bone, or suspected human bone, all excavation or grading in the vicinity of the find shall halt immediately and the area of the find shall be protected and the University immediately shall notify the Riverside County Coroner of the find and comply with the provisions of State Health & Safety Code § 7050.5.

2.6 NOISE ATTENUATION MEASURES

A. Require Mufflers and Other Noise Attenuators on Project Construction Equipment.

1. All contractors, and overseen by the Design-Builder, shall ensure that noise- producing construction equipment and vehicles using internal combustion engines will be equipped with mufflers; air-inlet silencers where appropriate; and any other shrouds, shields, or other noise-reducing features in good operating condition that meet or exceed original factory specification. Mobile or fixed "package" equipment (e.g., arc-welders, air compressors) will be equipped with shrouds and noise-control features that are readily available for that type of equipment.
2. Stationary construction equipment, material and vehicle staging shall be placed to direct noise away from sensitive receptors.

B. Require Use of Electrically Powered Equipment.

1. All contractors, and overseen by the Design-Builder, shall ensure that work use electrically powered equipment instead of pneumatic or internal combustion–powered equipment, where feasible.

2.7 TRANSPORTATION AND TRAFFIC

A. Traffic Control Plan for Project Construction.

1. All contractors shall comply with a University reviewed and approved Traffic Control Plan for project construction prepared by the Design-Builder prior to the commencement of construction.
2. To the extent feasible, all contractors, and those overseen by the Design-Builder, shall restrict vehicle traffic not associated with parking personal vehicles in permitted

parking lots to the Design-Builder provided temporary construction service road and North Campus Drive.

3. To the extent feasible, all contractors, and those overseen by the Design-Builder, shall maintain at least one unobstructed lane in both directions on existing campus roadways while performing the Work. At any time only a single lane is available, all contractors, and those overseen by the Design-Builder, shall provide a temporary traffic signal, signal carriers (i.e., flag persons), or other appropriate traffic controls to allow travel in both directions. If construction activities require the complete closure of a roadway segment, all contractors, and those overseen by the Design-Builder, shall provide appropriate signage indicating alternative routes.
4. To maintain adequate access for emergency vehicles when construction activities would result in roadway closures, the contractor will give fourteen (14) calendar day notice to the University's Representative, so that the University Office of Architects and Engineers can consult with the UCPD, EH&S, and RFD, as appropriate to disclose closures and identify alternative travel routes.
5. The hauling and disposal of any excess clean soil excavated from or already stockpiled on the site will be the responsibility of the Design-Builder to transport and stockpile it at the UCR Ag Ops area, or University approved location as directed by the University's Representative.

B. Pedestrian Access Plan for Project Construction.

1. All contractors will comply with a University reviewed and approved Pedestrian Access Plan for project construction prepared by the Design-Builder prior to the commencement of construction. At a minimum the Plan will include, alternate routes, appropriate signage, and curb cuts at street crossings to assure alternate routes around all construction sites or areas under the control of the Design-Builder are accessible during all phases of the Project.

END OF SECTION 01 3540

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Quality assurance and quality control.
2. Quality Control Plan.
3. Inspection
4. Special Inspection and Testing.
5. Mockups.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Design Builder of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Design Builder's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Design Builder to provide quality-assurance and -control services required by University's Representative, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

A. Inspector of Record: (I.O.R.) Employed by the University to observe, inspect and conduct tests required or deemed necessary to confirm work is in accordance with the contract documents, California Code of Regulations or other applicable regulatory requirements.

B. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

C. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work

and completed construction comply with requirements. Services do not include contract enforcement activities performed by University's Representative.

D. Mockups: Full-size, physical assemblies that are constructed on-site to illustrate finish and materials. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

E. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

F. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

G. Special Inspection and Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct special inspection and testing and acceptable to University's Representative, to establish performance and compliance with industry standards.

H. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

I. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

J. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

K. Installer/Applicator/Erector: Design Builder or another entity engaged by Design Builder as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

L. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of California Code of Regulations to work in California.

M. Inspection Request: Written request submitted by the Design Builder to the University's Representative for inspection of completed work.

1.3 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to University's Representative for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to University's Representative for a decision before proceeding.

1.4 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written inspection and testing report that include the following:

1. Date of issue.
2. University's Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For University's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

E. Quality Control Plan: Prepare and submit a plan describing procedures and methods the Design Builder will utilize to control the quality of the Work as specified in "Quality Control Plan" Article.

1.5 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Approved Fabricator Qualifications: Special inspections required by this section are not required where off-site fabrications are done on the premises of a fabricator approved by the University. The firm shall comply with the requirements of the California Building Code Section 1701.7.

F. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.

G. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

H. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and that is acceptable to University's Representative.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Design Builder's responsibilities include the following:

   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   f. When testing is complete, remove test specimens, assemblies, Type 2 mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Design Builder, with copy to University's Representative. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by University's Representative.
2. Notify University's Representative 14 days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain University Representative's approval of mockups before starting work, fabrication, or construction.
5. Type 1 Mockups: An in-place review of items, areas, materials and systems prior to execution, with approval by University's Representative. It is not the intent to modify materials or installation but to verify quality control expectations of the Design Builder. The mockups shall include all materials, finishes, outlets, fixtures, structural elements and construction details to complete the finished appearance of a room or area. The exact location shall be verified with the Design Builder's sequencing and the University's Representative.

6. Type 2 Mockups: The Type 2 mock-up is an independent structure and is not intended to be a part of the completed building or system within the building. It is the intent to verify material, interface of systems, and to establish the minimum quality that is required. The Type 2 mock-up is not intended to replace product samples required by individual Sections in Divisions 02 through 33.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed, unless otherwise indicated.

L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 02 through 33.

M. Special Inspector Qualifications: An individual with the demonstrated experience and capability to conduct special testing and inspecting of the particular type of construction or operation requiring special inspection.

1.6 QUALITY CONTROL

A. University Responsibilities: Where quality-control services are indicated as University's Responsibility, University will engage a qualified testing agency to perform these services.

1. All work performed by the Design Builder shall be observed and inspected by the University’s Inspector of Record for compliance with the Contract Documents, applicable codes and regulatory requirements.
2. All materials, products, equipment, off-site fabrications and assemblies shall be inspected by the University’s Representative or Inspector of Record for compliance upon delivery to the project site and prior to installation.
3. University will furnish Design Builder with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
4. Coordinate all activities associated with University’s Consultants and other University Departments.
5. Payment for these services will be by the University, except for transportation and daily living expenses outside of Riverside County shall be reimbursed by the Design Builder in order to comply with the Design Builder’s off-site fabrication or construction.
6. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Design Builder, and the Contract Sum will be adjusted by Change Order.

B. Design Builder’s Responsibilities: Tests and inspections not explicitly assigned to the University are the Design Builder's responsibility. Perform quality-control services required of Design Builder by California Codes to verify and confirm quality of materials, off-site fabrication, pre-fabricated assemblies, pre-assembled equipment and systems whether specified or not.

1. Where services are indicated as Design Builder's responsibility, or where quality standards for materials can not be verified, engage a qualified testing agency to perform these quality-control services.

a. Design Builder shall not employ same entity engaged by University, unless agreed to in writing by University.

2. Notify testing agencies and the University's Representative at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Design Builder's responsibility, submit a certified written report, in duplicate, of each quality-control service to the University's Representative.
4. Testing and inspecting requested by Design Builder and not required by the Contract Documents are Design Builder's responsibility.
5. Additional tests or special inspections required to establish that such portion of the Work complies with the Contract Documents.
6. Do not cover any piping, wiring, ducts, or other installations until they have been inspected and approved by the University's Representative.
7. In addition, the Design Builder shall be responsible for reimbursement to the University for:

   a. Reimbursement for travel and daily living expenses which are beyond normal inspection costs, when the University's Testing Laboratory or inspector is required to conduct inspections outside of the Orange County/Los Angeles County area.
   b. Cost of retesting construction revised or replaced construction by the Design Builder, where required tests were performed on original construction.
   c. Cost of retesting construction used as temporary facilities by the Design Builder.
   d. Costs of testing construction required by the Design Builder's substitutions.

8. Submit additional copies of each written report, when they so direct by the University's Representative.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Design Builder's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

1. If such additional tests or inspections establish that such portion of the Work fails to comply with the Contract Documents, all costs of such additional tests and inspections, and all other costs resulting from such failure, including compensation for University's Representative and University's consultants, shall be deducted from the Contract Sum by Change Order

E. Testing Agency Responsibilities: Cooperate with University's Representative and Design Builder in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify University's Representative and Design Builder promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Design Builder.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Design Builder.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.
2. Do not cover any piping, wiring, ducts, or other installations until they have been inspected and approved by the University's Representative or certified, if certification is required.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 60 days of date established for the Notice to Proceed.

1. Distribution: Distribute schedule to University's Representative, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.7 SPECIAL INSPECTION and TESTING

A. Special Inspection and Tests : University will engage a qualified special inspector to conduct special inspection and tests required by the California Building Codes as the responsibility of the University, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying University's Representative promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to University's Representative with copy to Design Builder.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

1.8 UNIVERSITY'S INSPECTORS

A. The IOR shall report to University's Representative. The IOR shall observe construction in progress and shall have the following responsibilities and limitations on authority.

1. Act under the direction of University's Representative.
2. Observe installation and work in progress as a basis for determining conformance of the work, materials and equipment with the Contract Documents. IOR will report any discrepancies observed to University's Representative and Design Builder. Only University's Representative has the final authority to make approvals or rejections.
3. Only University's Representative shall interpret the requirements of the Contract Documents. If any item is ambiguous, University's Representative shall make a written interpretation. If Design Builder requests changes or modifications to the Contract Documents, University's Representative shall make a written determination on the requested changes or modifications.
4. Prepare and submit an inspection report to University's Representative for each inspection performed.
5. Review application for payments.
6. Assist University's Representative in reviewing the test and inspection results of testing laboratories.
7. The IOR is not authorized to permit deviations from the requirements of the Contract Documents unless such deviation has been approved by University's Representative in writing.
8. The IOR shall not supervise, coordinate, or direct the Work. The IOR has no responsibility or control over Design-Builder's construction means, methods, techniques, sequences, procedures, or coordination of any portions of the Work, or over any safety programs in connection with the Project

B. The failure of University, University's Representative and its representatives and consultants, or University's IOR to observe or inspect the Work, or to detect deficiencies in the Work, or to inform Design Builder of any deficiencies which may be discovered, shall not relieve Design Builder, its subcontractors regardless of tier, or suppliers from their responsibility for construction means, methods, techniques, sequences and procedures, construction safety, nor from their responsibilities to carry out the work in accordance with the Contract Documents and to detect and correct defective work as defined in the General Conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials and finishes for mockups shall comply with the requirements specified in the various applicable sections of the specifications, and shall match previously submitted and approved samples.

B. Mockups shall incorporate all related construction materials and finishes upon the completed Work.

PART 3 - EXECUTION

3.1 INSPECTION REQUESTS:

A. Submit inspection request to the University's Representative at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.

B. All work performed by the Design Builder or sub-contractors shall be reviewed and approved for compliance with the Contract Documents by the Design Builder prior to submittal of the Inspection Request.

C. Design Builder's responsibility on the day on inspection:

1. Have plans that are stamped "Reviewed for Conformance" by the University available at the construction site.
2. Have product, material or equipment Submittals marked "NET or MCN" to show approval by the University available at the construction site.
3. Submit Inspection Request 48 hours in advance of inspections and material and equipment deliveries.
4. Provide equipment, utilities, lighting and access necessary for University's Representative to conduct inspections.

3.2 QUALITY CONTROL PLAN

A. Prepare a plan describing procedures and methods the Design Builder will utilize to control the quality of the Work. At a minimum the Quality Control Plan shall include:

1. An organizational structure description, including Quality Control supervision and inspection reporting structure. Delineate personnel training and qualification activities.
2. Plans and procedures for testing and inspections to verify attributes delineated in the Contract Documents, including those specified in referenced Codes and standards. Include documents that identify individual inspection or testing points and acceptance criteria, and include provisions for recording results and the responsible inspection/test personnel. This documentation shall be traceable to the particular material, items, processes or systems evaluated, including notification requirements.
3. Procedures for identifying and contractually invoking the applicable technical and quality requirements delineated in the Specifications on vendors supplying materials, parts and services.
4. Plans and procedures for receiving, inspecting and accepting material and items. These shall include examination of physical condition and compliance with purchasing requirements, including markings for class type and grade, and conformance of supplied documentation. These shall also include provisions for:

    a. Identifying, controlling and processing non-conforming items, including notification of the University's Representative.
    b. Inspection of materials for authenticity to preclude counterfeit parts, for items and attributes of concern identified by University's Representative.
    c. Verifying for compliance and traceability, maintaining, and turnover to the University, certificates of conformance and mill certificates required by Contract Documents or codes or standards invoked, for materials received.

5. Provisions for identifying defective Work. Bring to University Representative's attention, for consultation and possible relief, those cases where correction within the specified requirements may introduce a significant schedule penalty, personnel hazard, or compromise the quality of installed items, or is otherwise impractical.
6. Controls to assure that only the "Reviewed for Conformance" construction documents are utilized in the Work.

    a. This includes provisions for removing superceded versions from the work area, except where explicitly and prominently marked "Void -For information only"; such as to retain annotated installation data.

7. Detailed formal procedures or instructions for the performance of special processes, such as welding or concrete placement. These procedures/instructions and personnel performing special processes shall be qualified and certified as required by codes and standards invoked in the Contract Documents.
8. Controls providing for periodic calibration of testing and measurement equipment, including unique equipment identification and calibration tracking.
9. Maintain records documenting the implementation of the above activities, including tests inspections, special process qualification and execution, vendor documentation and defective Work resolution. These records shall be indexed, protected and retrievable for final submission to University's Representative.
10. Identify all test and inspections that the Design Builder proposes to be conducted by the University.

3.3 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to University's Representative.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for University Representative's reference during normal working hours.

3.4 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

B. Protect construction exposed by or for quality-control service and special inspection and testing activities.

C. Repair and protection are Design Builder's responsibility, regardless of the assignment of responsibility for quality-control services or special inspection and testing activities.

D. Maintain and protect the mockups during construction to serve as a standard for approving work incorporated into the Project. Do not alter, remove or destroy mockups until University's Representative authorizes their removal.

3.5 MOCKUP INSTALLATION

A. Mockups shall be constructed in accordance with the approved construction drawings, specific mock-up drawings, and approved shop drawings and product data. If changes are required, the Design Builder shall complete modifications to all documents.

B. Type 1 Mockups shall be revised as required to achieve proper quality control standards that shall be achieved by the Design Builder.

C. Type 2 Mockups shall be located where directed, and shall not be built "in place" as part of the permanent construction. Periodic inspections by the University and Design Builder will be given during the construction process to review the installation.

1. Insofar as possible, mockups shall illustrate contiguous materials and finishes, and be arranged in the same relationship, as they will appear in the finish construction.
2. Each kind of material shall be fabricated, installed and finished by the various subcontractors or others who will be furnishing and performing the Work in the permanent construction.
3. Protect and clean as required to leave the mock-up and adjacent areas in proper condition, upon completion of the Work.

4. Remedial measures, which may be necessary on mockups, shall maintain standards of quality and durability required by the Contract Documents, and shall be subject to approval by the University's Representative.
5. When so directed by the University's Representative, Type 2 mockups shall be dismantled and the materials disposed of by the Design Builder.
6. Type 2 Mockups shall be approved by the University's Representative, before materials are ordered for the Project.

3.6 MOCKUP INSPECTION

A. Notify University's Representative at the start of construction of mockups and provide progress reports to allow the University's Representative to schedule inspections.

B. After approximately 50 percent of each mockup has been built, request University Representative's preliminary review before completion. Incorporate visual and technical changes or variations requested by the University's Representative into mockups during their construction and prior to their completion, insofar as possible.

C. Obtain University Representative's acceptance of visual and technical qualities of mockups before commencing the corresponding Work for the Project.

D. Should the Type 1 or Type 2 mockups fail to meet the University Representative's approval, they shall be taken down or dismantled, and reconstructed to the extent necessary, until acceptance has been obtained.

E. Time the completion and reworking of mockups necessary to obtain acceptance to avoid delay in the construction schedule of the Project. Update the Construction Schedule to reflect required revisions to mockups.

INSPECTION REQUEST

TO:_____ NUMBER: _____

FROM:_____ DATE: _____

DWG REF:_____DETAIL:_____

SHOP DWG:_____

PROJECT SCHEDULE ACTIVITY ID NO._____

DATE OF INSPECTION:_____TIME OF INSPECTION:_____

TYPE OF INSPECTION:_____

SPECIFIC LOCATION OF INSPECTION (IE. FLOOR, COL LINE, ETC.):

_____

_____

_____

_____

_____

ALL WORK REQUESTED FOR INSPECTION HAS BEEN REVIEWED FOR COMPLIANCE WITH THE CONTRACT DOCUMENTS BY DESIGN BUILDER'S SUPERINTENDENT PRIOR TO NOTIFICATION OF INSPECTION REQUEST.

SIGNED:_____DATE:_____

UCR USE ONLY

DATE REC'D: _____

DATE OF INSPECTION:_____TIME OF INSPECTION:_____

INSPECTOR:_____ □ INSPECTION REPORT ATTACHED

COMMENTS:

_____

_____

_____

COPIES: □ UNIVERSITY □ CONSULTANTS □ _____ □ _____
□ FILE

NONCONFORMING WORK NOTICE

TO:_____ NUMBER: _____

FROM:_____ DATE: _____

SPEC. SEC. REF.:_____PARA:_____DWG REF:_____DETAIL:_____

DESCRIPTION OF DEFECTIVE CONDITION:_____

_____

_____

_____

_____

REPORTED BY: _____

CORRECTIVE ACTION SHOULD BE TAKEN AS SOON AS POSSIBLE AND COORDINATED WITH THE INSPECTOR OF RECORD. IF FURTHER INFORMATION IS NEEDED, ADVISE THE UNIVERSITY'S REPRESENTATIVE.

DESCRIPTION OF CORRECTIVE ACTION TAKEN: _____

_____

_____

_____

_____

_____

ACCEPTED BY:_____DATE:_____

cc:

END OF SECTION 01 4000

SECTION 01 4100 – REGULATORY REQUIREMENTS

1.1 SUMMARY

A. Section Includes:

1. The standards and codes applicable to the Work.
3. Regulatory notifications

B. Related Requirements:

1. Design Builder's Use of the Project Site: Section 01 1400
2. Reference Standards: Section 01 4200.

1.2 APPLICABLE CODES AND STANDARDS

A. Codes which apply to this Project include, but are not limited to, the following including additions, changes, and interpretations adopted by the enforcing agency in effect as of the date of these Contract Documents.

1. California Code of Regulations (CCR)

a. Title 8, Industrial Relations
b. Title 17, Public Health
c. Title 19, Public Safety
d. Title 20, Public Utilities and Energy
e. Title 21, Public Works
f. Title 22, Environmental Health
g. Title 24: Building Standards Code
   1) Part 2, California Building Code
   2) Part 3, California Electric Code
   3) Part 4, California Mechanical Code
   4) Part 5, California Plumbing Code
   5) Part 6, California Energy Code
   6) Part 7, California Elevator Safety Construction Code
   7) Part 9, California Fire Code
   8) Part 11, California Green Building Standards Code
   9) Part 12, California State Reference Standards

B. In addition to the above codes, work shall comply with the following:

1. California Environmental Quality Act (CEQA).
2. California Health and Safety Code.
3. California Occupational Safety and Health Act Standards (Cal-OSHA).
4. California Department of Transportation (Caltrans): Standard Specifications, latest edition.
5. National Fire Protection Association (NFPA): Standards 13, 24, 72, and 80.
6. Americans with Disabilities Act - Title II (ADA).
7. Federal Occupational Safety and Health Act (OSHA).

8. Federal Environmental Protection Agency – Clean Air Act.
9. Storm Water Pollution Prevention Act.

C. All work shall meet or exceed code requirements.

D. References in the Specifications to "code" or to "building code," not otherwise identified, shall mean the foregoing specified codes, together with the additions, changes, amend- ments, and interpretations adopted by the enforcing agency and in effect on the date of these Contract Documents.

E. Where other regulatory requirements are referenced in these Specifications, the affected work shall meet or exceed the applicable requirements of such references.

F. Regulatory requirements referred to shall have full force and effect as though printed in these Specifications.

1.3 OTHER APPLICABLE LAWS AND REGULATIONS

A. All applicable federal, state, and local laws and the rules and regulations of governing util- ity districts and the various other authorities having jurisdiction over the construction and completion of the Project, including the latest rules and regulations of the state fire marshal, OSHA, and the California Labor Code, shall apply to the Contract throughout, and they shall be deemed to be included in the Contract the same as though printed in these Specifications.

1.4 CONFLICTS

A. Nothing stated in this Section of the Specifications or other Sections of the Specifications, the other Contract Documents shall be construed as allowing Work that is not in strict compliance with all applicable Federal, State, regional, and local statutes, laws, regula- tions, rules, ordinances, codes and standards.

B. Unless otherwise directed by the University's Representative, if a conflict exists be- tween referenced regulatory requirements and the Contract Documents, comply with the one establishing the more stringent requirements.

1.5 TRENCHING AND SHORING

A. All Work shall be in full accordance, but not necessarily limited to the following codes and regulations: Titles 8, 19, 21, 22, & 24, State of California, California Code of Regulations (CCR), California Occupational Safety and Health Administration (OSHA). For Additional requirements refer to Section 01 1400 Design Builder’s Use of the Project Site.

1.6 REGULATORY NOTIFICATIONS

A. Submit all required notifications to Federal, State of California, State in which disposal facil- ity is located if not in California, regional, and local agencies with regulatory responsibilities associated with the Work activities that are included in the Contract. All notifications shall be served in writing, in the form required by the agency requiring notification, and in a time- ly manner so as not to negatively impact the Project schedule. Serve notifications at least 10

business days in advance (or earlier if required by agency) of activity requiring notice. The Design Builder shall serve all required notifications in writing to all governmental and quasi-government agencies having notification requirements pertaining to any portion of the Work included in the Project.

B. Design Builder shall file a Notice of Intent for coverage under State General Construction Activity Storm Water Permit National Pollutant Discharge Eliminate System (NPDES). Design Builder shall comply with applicable permit requirements including the project Storm Water Pollution Prevention Plan.

1.7 PERMITS, NOTIFICATIONS, AND CERTIFICATES

A. Underground Service Alert (USA) Notifications: Prior to commencing clearing, excavation and trenching, coordinate with Underground Service Alert of Southern California for field verification and marking of utilities within the limits of Project site. Design Builder shall be responsible for outlining limits of excavation with white chalk paint prior to coordination with USA. Coordination shall require 2 business days advance notification prior to start of excavation work. Provide USA notification permit number to the University's Representative prior to starting site Work.

B. In no event, shall the Design Builder install materials that contain asbestos, PCB, lead or other known hazardous materials unless prior written approval is obtained from the University.

C. Regulated Carcinogens by Title 8 California Code of Regulations (CCR), Subchapter 7, Group 16 (Control of Hazardous Substances), Article 110 (Regulated Carcinogens).

1. Products containing chemicals regulated as carcinogens by the State of California are not allowed for use on University projects.
2. Case-by-case exceptions may be considered for products containing the following Cal/OSHA recognized carcinogens:

    a. Methylene Chloride, 5202
    b. Cadmium, 1532, 5207
    c. Inorganic Arsenic, 5214
    d. Formaldehyde, 5217
    e. Benzene, 5218

3. Case-by-case exceptions may only be made when suitable alternative products are not available. Such exceptions are subject to written approval by the University's Representative.
4. Exceptions require that the Design Builder shall have an established carcinogen program as required by Cal/OSHA (§5203. Carcinogen Report of Use Requirements) and shall submit to University's Representative, a copy of the Cal/OSHA Confirmation of Report for Cal/OSHA carcinogens.
5. When exceptions are granted, the Design Builder is responsible for providing to the University's Representative a copy of the semi-annual Confirmation of Report received from Cal/OSHA or, in lieu of that, a copy of the Design Builder's semi-annual report as submitted to Cal/OSHA at periods not to exceed 6 months, or at project closeout, whichever occurs first.

C. Fire Department and Additional Notifications, Manifests, and Requirements: As required by University and coordinated by Design Builder with the University's Representative.

END OF
SECTION

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. "Approved": The approval of The University's Representative or University, as called for by Contract Documents.

B. "Directed": A command or instruction by University's Representative. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

C. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

D. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

E. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

F. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

G. "Provide": Furnish and install, complete and ready for the intended use.

H. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530

AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(405) 780-7372
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association	(239) 454-6989

	www.archprecast.org	
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industry International) www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCSC)	
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWPA	American Wood-Preservers' Association www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association	(212) 297-2122

	www.buildershardware.com	
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
CCC	Carpet Cushion Council www.carpetcushion.org	(610) 527-3880
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association	(800) 510-2772

	www.cppa-info.org	(202) 462-9607
CRI	Carpet & Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Cast Stone Institute www.caststone.org	(717) 272-3744
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association www.esda.org	(315) 339-6937
FM Approvals	FM Approvals www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000

FMRC	Factory Mutual Research (Now FMG)	
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Now GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830

IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek Testing Service NA www.intertek.com	(972) 238-5591
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association, Inc.	(847) 480-9138

	www.maplefloor.org	
MFMA	Metal Framing Manufacturers Association www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698

NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (303) 697-8441
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association) www.nofma.org	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930

NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
OPL	Omega Point Laboratories, Inc. (Now ITS)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America) www.landcarenetwork.org	(800) 395-2522 (703) 736-9666
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.calredwood.org	(888) 225-7339 (415) 382-0662
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(516) 294-5424

SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333

SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrasssod.org	(847) 649-5555 (800) 405-8873
TRI	Tile Roofing Institute www.tileroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (Now WCSC)	
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 297-2109

WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WIC	Woodwork Institute of California (Now WI)	
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CCR (CBC)	California Code of Regulations, Title 24, also known as the California Building Standards Code www.bsc.ca.gov	(916) 263-0916
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	

UBC	Uniform Building Code (See ICC)	

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://.dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999

PBS	Public Building Service (See GSA)	
PHS	Office of Public Health and Science www.osophs.dhhs.gov/ophs	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the organizations responsible for the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CBHF	State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation www.dca.ca.gov/bhfti	(800) 952-5210 (916) 574-2041

CCR	California Code of Regulations www.calregs.com	(916) 323-6815
CPUC	California Public Utilities Commission www.cpuc.ca.gov	(415) 703-2782
SCAQMD	South Coast Air Quality Management District www.aqmd.gov	(800) 288-7664
SWRCB	State Water Resources Control Board www.swrcb.ca.gov	(916) 341-5537

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 4339 - EXTERIOR WALLS MOCKUPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for exterior walls mockup construction, on-site mockups and testing.

B. Mockups, testing, and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific mockup and testing requirements for individual elements of the Work are specified in the Sections that specify that Work. Requirements in those Sections may also cover production of standard products.
2. Specified mockups, tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide mockup construction and testing, including those required by authorities having jurisdiction, are not limited by provisions of this Section.

C. Related Requirements:

1. Mockup Drawings.
2. Section 01 4000 "Quality Requirements" mockup and testing requirements, and individual exterior systems Specification Sections mockup and testing requirements, apply to the Work of this Section.
3. Section 01 4100 "Regulatory Requirements"
4. Section 01 4200 "Reference Standards"
5. Section 01 4550 "Roofing and Waterproofing Inspection Services
6. Section 03 3000 "Cast-in-Place Concrete"
7. Section 03 3300 "Architectural Concrete"
8. Section 03 3300.16 "Stratified Concrete Wall"
9. Section 03 4500 "Precast Architectural Concrete"
10. Section 04 2613 "Masonry Veneer"
11. Section 05 1200 "Structural Steel"
12. Section 05 3100 "Steel Decking"

13. Section 05 4000 "Cold-Formed Metal Framing"
14. Section 05 5000 "Metal Fabrications"
15. Section 05 5213 "Pipe and Tube Railings'
16. Section 05 7313 "Glazed Decorative Metal Railings"
17. Section 06 1053 "Miscellaneous Rough Carpentry"
18. Section 06 1600 "Sheathing
19. Section 07 1800 "Traffic Coatings"
20. Section 07 2100 "Thermal Insulation"
21. Section 07 2726 "Fluid-Applied Membrane Air Barriers"
22. Section 07 4113.13 "Formed Metal Roof Panels"
23. Section 07 4213.13 "Formed Metal Wall Panels"
24. Section 07 4213.23 "Metal Composite Material Wall Panels"
25. Section 07 4229 "Terra Cotta Baguette/Louver System"
26. Section 07 5419 "Thermoplastic Polyvinyl-Chloride (PVC) Roofing"
27. Section 07 6200 "Sheet Metal Flashing and Trim"
28. Section 07 7100 "Roof Specialties"
29. Section 07 8443 "Joint Firestopping"
30. Section 07 9200 "Joint Sealants"
31. Section 07 9513.16 "Exterior Expansion Joint Cover Assemblies"
32. Section 08 4113 "Aluminum-Framed Entrances and Storefronts'
33. Section 08 4229.33 "Swinging Automatic Entrances'
34. Section 08 4413 "Glazed Aluminum Curtain Walls'
35. Section 08 8000 "Glazing'
36. Section 09 2400 "Cement Plastering'
37. Section 09 9113 "Exterior Painting'
38. Section 09 9600 "High-Performance Coatings'
39. Section 09 9654 "Polyvinylidene Difluoride (PVDF) Coating System"

1.3 DEFINITIONS

A. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between adjacent materials and systems; and to demonstrate compliance with specified installation tolerances. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Standalone Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
2. Building Integrated Exterior Mockups: Mockups of the exterior envelope erected into the building fabric. These mockups, if successful, may be left in place as part of the completed work at the sole discretion of the Architect and Owner.

B. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

C. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

D. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

E. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

F. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

G. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

1.4 ACTION SUBMITTALS

A. Shop Drawings: For each type of exterior mockup, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, finish and color designations, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

C. Sample Construction: Process submittal for field samples as specified for product submittal, for documentation.

D. Delegated-Design Submittal: For standalone mockups to comply with structural requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified [professional engineer][testing agency].

B. Installation Instructions:

1. Include instructions specific to the use and conditions, including:
   a. Sequence of component/assembly
   b. Direction of operations for installation, unitized systems erection.
   c. Surface preparation requirements.
   d. All components of the system.
   e. Coordination requirements for adjacent systems where appropriate.
2. Provide 3 dimensional and "exploded views" to address components not easily expressed in orthographic drawings.
3. Maintain mockup installation instructions for mockup erection on location and make available to all parties throughout mockup construction, testing, and reference.

C. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities

D. Qualification Data: For Contractor's quality-control personnel.

E. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

F. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests.
3. Description of test.
4. Identification of applicable standards.
5. Identification of test methods.
6. Number of tests required.
7. Time schedule or time span for tests.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

G. Mock-up Completion: Process submittal for documentation when mock-up is complete.

1.6 CONTRACTOR'S MOCKUP AND TESTING PLAN

A. Mockup and Testing Plan, General: Submit plan for mockup fabrication, construction, and testing before proceeding with Project submittals for associated exterior envelope Work.

1. Include the following information in this plan, at a minimum:
    a. Mockup shop drawing and submittals schedule.
    b. Lead time for obtaining required mockup materials.
    c. Times for testing, and if necessary, retesting of mockups.

1.7 REPORTS AND DOCUMENTS

A. Test Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests.
5. Names of individuals making tests.
6. Description of the Work and test method.
7. Identification of product and Specification Section.
8. Complete inspection data.
9. Test results and an interpretation of test results.
10. Record of temperature and weather conditions at time of testing.
11. Comments or professional opinion on whether tested Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

B. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups as indicated to adequately demonstrate capability of products to comply with performance requirements.
   d. Where size and configuration are not indicated by documents, provide sizes and configurations of test assemblies, mockups, and laboratory mockups to replicate project conditions at full scale.
   e. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   f. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   g. When testing is complete, remove and dispose test specimens, assemblies, [and]mockups unless otherwise indicated; do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

C. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect or Construction Manager.
2. Notify Architect and Construction Manager 14 days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's and University Representative approval of mockups before starting work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

7. Notify Architect and University Representative 14 days prior to proposed date of mockup removals. Proceed with demolition only upon written agreement by Architect and University Representative .

8. Demolish and remove mockups only when directed by Architect or and University Representative unless otherwise indicated.

D. Standalone Exterior Mockups: Prior to commencing exterior construction, build freestanding mockup of exterior assemblies according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

E. Building Integrated Exterior Mockups: Prior to commencing exterior construction, build freestanding mockup of exterior assemblies according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1. Construct in-place mockup as indicated for field quality control testing indicated.

F. Laboratory Mockups: Comply with requirements of preconstruction testing as specified in individual Specification Sections.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.

3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Schedule testing agencies functions sufficiently in advance of testing or inspecting to allow Architect and University Representative observations.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's/Fabricator's Technical Services: Engage manufacturer's technical representatives to observe and inspect the mockups. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed mockups, witnessing testing, and submittal of written reports.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Architect University Representative and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect University Representative and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. Coordinate the location from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect,University Representative testing agencies, and each party involved in performance of portions of the mockups and testing.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TRACKING AND RELOGGING

A. Tracking: Prepare plan and elevations indicating locations and results of testing for integrated exterior mockups. Update testing completion as work proceeds.

B. Submit: With record documents.

1. Provide updated copies of documents to Architect and and University Representative upon completion of mockups and testing by type and location.

3.2 REPAIR AND PROTECTION

A. General:

1. Protect standalone mockups until released for demolition or removal from Site by Architect, Owner and University Representative .

END OF SECTION

SECTION 01 4550 - ROOFING AND WATERPROOFING INSPECTION SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for roofing and waterproofing inspection services.

B. Related Sections include the following:

1. Division 01 Section, “Project Management and Coordination” for meeting requirements.
2. Division 07 Section, “Cold Fluid-Applied Waterproofing” for waterproofing requirements.
3. Division 07 for roofing requirements.

1.2 REFERENCE PUBLICATIONS

A. "Quality Control in the Application of Built-Up Roofing" published and available from National Roofing Contractors Association, 8600 Bryn Mawr Avenue, Chicago, IL 60631-3502, (312) 693-0700.

B. NRCA Roofing and Waterproofing Manual published as noted in paragraph A above.

1.3 SUBMITTALS

A. Review the roofing and waterproofing system(s) submittal and keep one set of submittals after final approval by University's Representative.

B. Secure University's Representative prior approval of date and time for preconstruction conference, all substrate inspections and preinstallation conference meetings.

1. Notify the inspection service, the subcontractor(s), system manufacturer(s), authorized representative(s) and other interested parties, and secure their agreement to attend.
2. At least 72 hours prior to the preconstruction meeting notify the University's Representative of the names of persons expected to attend.

C. Records:

1. Maintain a complete and legible file, in chronological order, containing a copy of each report, certificate, and other communication received relative to the Work of this Section.
2. Upon completion of the Work of this Section, deliver a copy of the complete file to the University's Representative.
3. Maintain file of photographs of critical phases of installation as determined with University's Representative at pre-installation meeting.

1.4 ROOFING AND WATERPROOFING INSPECTION SERVICES

A. For the Work of this Section, the inspection agency is subject to approval by University's Representative**.**

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

A. A pre-construction conference shall be held during the initial phase of construction between University's Representative, Design Builder, Design Builder's Superintendent and all related subcontractors directly involved with potential failure of the membrane(s) due to inferior workmanship, defects, etc. and who shall be responsible for the construction.

B. Drawings and Specifications shall be reviewed in detail. Resolve differences between the Specifications of the Design Builder’s Architect and the specifications of the material manufacturer. Incorporate these decisions into the job record either as field orders or as change orders.

C. Confirm that Drawings and Specifications contain provisions for the deck slope, drainage, surface condition, and nailers for attachment of the membrane and flashing.

D. Areas used by the roofing and/or waterproofing subcontractor to store materials and equipment shall be clearly established.

E. Establish required clearances for areas adjacent to waterproofing areas so that the handling of materials and application procedures can be performed in a safe manner.

F. Establish requirements for backfilling operations and for the use of scaffolding.

G. Establish installation procedures for mechanical devices that will penetrate the roofing and/or waterproofing membrane to prevent cutting the membrane after it is installed. Membrane penetrations shall be minimized.

H. If any roofed or waterproofed surface will be used as a working platform after the materials have been applied, an agreement must be reached on how and who will protect the membrane during this construction period.

I. The roofing and/or waterproofing manufacturer's representative, in coordination with University's Representative, Design Builder, and the inspection agency will determine whether the substrate surface meets the Contract Document requirements and pre-construction agreements and is ready for the application of waterproofing materials.

J. If the Design Builder is instructed to proceed over what it determines to be an unsatisfactory surface, it shall:

1. State its objections in writing to University's Representative; and
2. Include in its statement a copy of the instructions given; and
3. Inform the other associated parties of its objections.

K. Agreement shall be reached determining who will approve the waterproofing Work and who will be present for required testing.

3.2 PRE-INSTALLATION MEETING

A. Conduct a substrata inspection and a pre-installation meeting within three to ten days prior to scheduled start of installation. Minutes of the meeting will be taken by the Design Builder, who will also distribute same to attending parties.

B. Visually inspect all substrata upon which roofing or waterproofing is scheduled to be applied.

1. Determine general acceptability, and determine areas requiring further preparation.
2. Determine acceptable remedies for unacceptable areas.

C. Discuss proposed schedule for installation of the membranes, and reach agreement as to dates of start and finish of installation.

D. Discuss proposed methods for installation of the membranes, and equipment and personnel to be used.

E. Discuss inspection methods to be used, reports to be issued by the inspector, responsibilities and limits of responsibilities of the inspector, and potential problems arising from use of methods not agreed to in the pre-installation meeting.

F. The manufacturer's representative shall instruct the University's inspector and the inspection agency how to verify the correct installation and the inspector shall be furnished with a copy of the manufacturer(s) literature and installation instructions at the jobsite. Deviations from the instructions shall only be allowed if approved in writing by the manufacturer's representative(s) and the University's Representative.

3.3 INSPECTION DURING ROOFING MEMBRANE INSTALLATION

A. The system manufacturer(s) or the authorized representative(s) shall be present on the Project site during installation continuously or at intervals as determined in the pre-construction conference.

B. Verify that materials delivered to the job site are those approved by the University's Representative for use on this Work.

C. Visually observe installation of membranes including, but not necessarily limited to:

1. Check kettle temperatures, and verify that bitumens are not heated beyond temperatures recommended by the manufacturer of the approved system materials.
2. At least three times daily, check temperatures of bitumens as delivered to the roof deck and verify that temperatures of bitumens are within the range recommended by the manufacturer of the approved membrane system materials.
3. Verify use of installation procedures agreed upon in the pre-installation meeting.
4. Call attention of Design Builder Superintendent and the subcontractor's representative on the job to unacceptable methods and unacceptable results.
5. Report to the Design Builder and to the University's Representative if the subcontractor fails to correct unacceptable methods or unacceptable results.
6. Verify that workers on the roof do not step on plies of felts while bitumen is still hot and for at least the same working day.

D. Make one test cut if directed by University's Representative prior to application of final surfacing.

1. Except as otherwise approved by the University's Representative, make the test cuts 12 inches square and through all layers of the membranes that are in place.
2. By precise weighing of identical 12-inch square pieces of felt, determine the amount of bitumens applied in the one square foot sample (roofing only).
3. Verify that the subcontractor provides proper patching of areas where test cuts were made.
4. Include within the daily report a statement of weights (and corresponding adequacy or inadequacy of membrane(s) at test cuts.

E. Make final visual inspection of the entire installation.

1. Compile a list of items required to be revised or replaced.
2. Deliver a copy of the list to the subcontractor(s), University's Representative, and to others as appropriate.
3. Verify proper revision or replacement of all items on the list.

3.4 INSPECTION DURING WATERPROOFING INSTALLATION

A. Verify that materials delivered to the jobsite are those approved by University's Representative.

B. Attend both pre-construction and pre-installation conferences between Design Builder, applicator, manufacturer, University's Representative and other subcontractors responsible for quality of substrates.

3.5 TESTING AND SAMPLING

A. Flood Testing shall be performed for horizontal membrane applications. The area to be tested shall be flooded until at least 1 inch of standing water covers the entire surface. In no case shall water be allowed to stand above the finished level of the membrane flashing. Drains shall be plugged, and permanent or temporary curbings shall be formed to retain the water for a period of at least 24 hours. Any leaks found during this period shall be repaired and the area re-tested.

B. When it is impractical, as determined by University's Representative, to flood-test and area because the slope of the substrate would cause excessive water build-up in places, the membrane can be tested by allowing water from a hose to run continuously over the area for a period of eight hours. During this period, the entire area must remain completely flooded.

C. If flood testing is impractical as determined by University's Representative that because of job conditions, weather, location, etc. perform a thorough inspection of the horizontal membrane. All laps, terminations, and flashings must be carefully checked for any evidence of fishmouths, incomplete adhesion or other conditions that may be detrimental to the watertight integrity of the membrane.

3.6 REPORTS

A. Make daily written reports of inspection activities, delivering copies to the subcontractor(s) and others as agreed in the pre-installation meeting.

B. Upon completion of the membrane installation(s), compile a comprehensive report covering activities performed under this Section, and deliver a copy of the report to:

1. University's Representative;
2. Design Builder and subcontractor(s);
3. Others as agreed in the pre-construction and pre-installation meetings.

3.7 LIMITS OF ROOFING AND WATERPROOFING INSPECTOR'S RESPONSIBILITIES

A. During progress of the installation, the inspection agency's inspector is required to:

1. Make visual observations and compile reports described in this Section;
2. Advise the University's Representative and the subcontractor's representative(s) on the job as to unacceptable methods and unacceptable results when so observed by the inspector.

B. In connection with the installation, "unacceptable methods and unacceptable results" mean methods and results other than:

1. Those required and recommended by the manufacturer of the approved system materials.
2. Those required by pertinent regulations of governmental agencies having jurisdiction.
3. Those required by the Specifications.
4. Those agreed upon in the pre-construction and pre-installation meetings.

C. The roofing and waterproofing inspector is not empowered to:

1. Act for, or in lieu of, representatives of authorities having jurisdiction;
2. Give directions to the Design Builder, subcontractor, or workmen on the job;
3. Revise any part of the Contract Documents; or
4. Approve any change in the methods agreed upon in the pre-installation meeting.

D. Failure of the inspector to observe unacceptable methods or unacceptable results during progress of the Work will not absolve the Design Builder from his responsibility to complete the Work in accordance with the specified requirements and the agreed methods.

END OF SECTION 01 4550

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:

1. Section 01 1000 Summary for limitations on utility interruptions and other work restrictions.
2. Section 01 3300 Submittal Procedures for procedures for submitting copies of implementation and termination schedule and utility reports.
3. Section 01 7300 Execution Requirements for progress cleaning requirements.
4. Divisions 02 through 33 Sections for specific requirements for temporary facilities and control requirements for products, materials and equipment in those Sections.

1.2 DEFINITIONS

A. Permanent Enclosure: As determined by University's Representative, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, University's construction forces, University's Representative, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Parking Permits: Limited parking for workers employed on the Work may be provided within the fenced-in Project site boundary and designated temporary construction lay-down area (parking lot25) to the extent that space for that purpose is available without interference with University activities or activities related to performance of the Work. Design-builder (and workers employed on the work) shall be provided parking permits by UCR for personal vehicles should they intend to utilize University parking lots on campus.

1. General parking for construction forces shall be coordinated with Design-builder, UCR Transportation and Parking Services (TAPS) and University Representative. Monthly parking passes are available for purchase at:
   683 Linden Street
   Riverside, CA 92521
2. Comply with the University's parking regulations.

C. Sewer Service: Where available, the University will pay sewer service use charges for sewer usage by all entities for construction operations.

D. Water Service: The University will pay water (potable and/or reclaimed water) service use charges for water used by all entities for construction operations when connected to the University water system.

E. Electric Power Service: The University will pay electric power service use charges for electricity used by all entities for construction operations when connected to the University electrical system.

F. Phone Service: The Univerisity will pay phone service and use charges for construction operations and University's Field Office.

G. Natural Gas Service: The University will pay natural gas service use charges to the University for gas used by all entities for construction operations when connected to the University natural gas system.

1.4 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Field Offices: Submit floor plans, list of equipment including product data, and evidence of regulatory approval.

C. Temporary Construction Service Road Plan: Submit plan for construction vehicle service road in proximity to the corner of Canyon Crest Drive and University Avenue. Temporary construction service road shall extend eastward to campus parking lot 19 allowing for a more streamlined access route to the project construction site. Show locations of curb-cuts, existing utilities and vaults to be protected in place, fencing, barricades, signage, etc. This temporary road plan shall be prepared by persons knowledgeable about the fundamental principles of temporary traffic controls and the work activities performed.
   1. Location of temporary construction service road shall be coordinated with University Representative.
      a. UCR is currently working with Riverside Transit Authority (RTA) on development of future RTA transit hub to be located at parking lot 19. Should project schedules coincide, it is the University's desire for temporary construction service road to be converted into permanent RTA transit hub service road.
   2. The Design-builder shall be responsible for patching, repairing, or replacing in like kind any adjacent areas damaged by project construction traffic during the Work immediately upon discovery.
   3. The Design-builder shall be responsible for removing the temporary construction service road and restoring area to (at minimum) the same condition as documented prior to the Work during project close-out.
      a. Photo document area prior to commencement of the Work. See specification section 01 3233 "Photographic Documentation" for more information.

D. Fence Plan: Submit site plan with construction fence around project, location of gates and fire access gates, for approval by the State Fire Marshal. Show location of any existing fire hydrants. Submittal shall include fence plans for any off project site lay down area if applicable.

1. Partial use of parking lot 19 is acceptable.
   a. Campus/pedestrian access shall be maintained.
      1) Point of access into lot 19 may be relocated as necessary to separate public/construction traffic if needed.
   b. Number/quantity of existing ADA accessible stalls shall not be reduced.
      1) Restriping parking lot 19 to accommodate any displaced accessible stalls is acceptable provided that code compliant stalls and path of travel to adjacent right of way is provided.
   c. University reserves the right to require reconfiguration of temporary fencing or designated construction lay-down area of parking lot 19 to a configuration acceptable to University when Design-builder is provided with 30 days written notice.

E. Storm Water Pollution Prevention Plan (SWPPP): Prepare the SWPPP in accordance with the General Permit to discharge storm water associated with construction activity. The SWPPP shall be prepared by an individual knowledgeable about storm water pollution prevention methods and requirements. The SWPPP shall be implemented prior to commencement of construction activities and shall include but not be limited to: the construction site, lay down area, remote contractor parking site (if provided) and the temporary trailer facilities. SWPPP shall include any off project site lay down area if applicable.

F. Traffic Control Plan: Submit traffic control plan for vehicular, pedestrian and bicycle traffic around the project construction site. Show locations of barricades, lights, and signage. Traffic control plans shall be prepared by persons knowledgeable about the fundamental principles of temporary traffic controls and the work activities performed. The design, selection and placement of traffic control devices for the traffic control plan shall be based on engineering judgment and in accordance with Part 6 of the California Manual on Uniform Traffic Control Devices for Streets and Highways.

G. Provide a schedule of any activity that will impact traffic, or any planned lane or street closure, for approval by the University's Representative and giving a minimum of 14 business days notice before closing any street, parking stall or access pathway.

H. Submit electronic copies of above submittals. University will return one copy.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with California Electric Code.

B. Tests and Inspections: Arrange for University’s Representative or the utility company’s to test and inspect each temporary utility before use. Obtain required certifications and permits.

1. Notify University's Representative 72 hours prior to connection to a University utility service to obtain permit with University Facilities Management approval.
2. Notify University's Representative after installation of backflow prevention device to obtain certification on installation from the University Facilities Management.

C. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Cal OSHA Requirements.
2. University's Environmental Health and Safety (EH&S) regulations.
3. South Coast Air Quality Management District (SCAQMD).
4. California State Fire Marshal.
5. Federal and State storm water management regulations for construction activities.

D. Standards: Comply with CFC Article 87, "Fire Safety during Construction, Alteration or Demolition of a Building" and ANSI A10 Series standards for "Safety Requirements for Construction and Demolition".

E. Permits: For projects one acre or more in size, a Notice of Intent (NOI) and Notice of Termination (NOT) shall be prepared under the General Permit for Storm Water Discharges. The NOI and NOT forms must be submitted to State Water Resources Control Board (SWRCB) through coordination with the University's Representative. Yearly permit fees are to be included for the duration of the project, until Notice of Termination is filed through SWRCB.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before University's acceptance, regardless of previously assigned responsibilities.

B. Site Ingress And Egress

1. **Restrict entering and exiting the campus to the temporary construction service road and parking lot 25 via Linden Drive.** No other streets may be used unless specified or approved in writing by University Representative.
2. Take all necessary precaution to ensure the safety of the bicyclists and pedestrians that use the campus roads, pathways or service drives.
3. During inclement weather, clean the roads, drives or pathways affected to prevent slickness of the surface. The surface shall be maintained in a safe and usable condition for motorists, bicyclists and pedestrians.
4. Construction operations are permitted to block only 1/2 of a street, drive or pathway at a time for momentary site access unless specified otherwise or approved. Campus streets shall be operational and usable by the University at all times.

C. Temporary use of parking spaces outside Limits of the Work:

1. Obtain written approval of the University's Representative if any existing parking spaces outside the Limits of the Work must be temporarily blocked or used for access, storage, loading, protection against damage from construction operations (paint overspray, etc.) or any other activity associated with the Work.
2. Request approval at least 3 business days in advance of the requested commencement of the use of the parking spaces. University reserves the right to refuse approval, with no change to the Contract Sum.

D. Protection: Where Work is in progress overhead and materials or objects could potentially fall, construct temporary covered pedestrian walkways over each building entrance or existing walkway. Walkway covers shall extend out 12 feet in length for the first floor and an additional 4 feet for each additional floor of the building. Walkway covers shall extend from face of building. Place and maintain yellow safety construction flagging or ropes with signage to prevent pedestrians from coming within 25 feet of Work in progress overhead and to route pedestrians in and out of building entrances.

E. Safety Precautions: Perform Work in such a manner as to prevent damage to existing facilities to remain or to be salvaged. Hazardous Work shall not be left standing or hanging, but shall be knocked or pulled down to avoid damage or injury to employees or the public.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials suitable for the use intended. If acceptable to the University's Representative, undamaged previously used materials in serviceable condition may be used.

B. Pavement: Comply with Division 32 pavement Sections.

C. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

D. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete or galvanized steel bases for supporting posts.

E. Lumber and Plywood: Comply with requirements in Division 06 Section "Rough Carpentry or Miscellaneous Carpentry" or as specified below.

1. For job-built fencing, temporary offices, shops and sheds within the construction area, provide UL labeled, fire treated lumber and plywood for framing, sheathing and siding.

2. For signs and directory boards, provide exterior type, Grade B Plywood conforming to PS-1, of sizes and thickness indicated.

F. Roofing Materials: Provide UL Class "A" standard weight asphalt shingles complying with ASTM D 3018, or UL Class "C" mineral surfaced roll roofing complying with ASTM D 249 on roofs of job-built temporary offices, shops and sheds.

G. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.

H. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

I. Paint: Comply with requirements in Division 9 painting Sections.

1. For job-built temporary offices, shops, sheds, fences and other exposed lumber and plywood, provide exterior grade acrylic-latex emulsion over exterior primer.
2. For sign panels and applying graphics, provide exterior grade alkyd gloss enamel over exterior primer.
3. For interior walls of temporary offices, provide two coats interior latex flat wall paint.

J. Tarpaulins: Provide waterproof, fire resistant, UL labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures provide translucent, nylon reinforced laminated polyethylene or polyvinyl chloride fire retardant tarpaulins.

K. Water Hoses: Provide 3/4 inch heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shutoff nozzles at hose discharge.

L. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

M. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

N. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Where exposed to breakage, provide lamps with guard cages or tempered glass enclosures. Provide exterior fixtures where exposed to moisture.

O. First Aid Supplies: Comply with governing regulations.

P. Metal plating and metal bridging for covering trenches shall be non-skid with waffle-patterns or right angle undulations or shall be coated with a non-skid product. Plating

shall be installed with no protruding edges or corners sticking up and with no bouncing or shifting.

2.2 TEMPORARY FACILITIES

A. General: Provide new facilities and equipment suitable for the use intended. If acceptable to the University's Representative, undamaged previously used materials in serviceable condition may be used.

B. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide steps and landings at all entrance doors.

C. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 12 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack board.
3. Drinking water and private toilet.
4. Coffee machine and supplies.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

D. Field Office for University's Representative: A separate space for sole use of University's personnel, with secure entrance doors and one key per occupant.
1. Provide minimum 8' wide deck with stair access and ADA ramp.
2. Provide one accessible parking stall (path graded as feasible for compliance) in close proximity to the access ramp of Field Office that is scheduled to accommodate University Representatives co-locating during project.
3. Space for 2 occupants per room from the University.
4. 750 square feet minimum with minimum width dimension of 10 feet.
5. Provide a contiguous space with four (4) secured private offices at 150 S.F. each, and a central space of 300 S.F.
6. The University's Inspector's office shall accommodate 2 inspectors and a table sufficient to review plans and have a separate outside door access.
7. Windows:

    a. Minimum: Total area of 10 percent of floor area.
    b. Operable sash and insect screens.
    c. Locate to provide view of construction areas.

8. Interior toilet and sink with all plumbing lines connected to services and water heater.

9. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
10. Electrical:

    a. Exterior lighting at entrance door.
    b. Minimum of four 110 volt duplex electric convenience outlets, at least one on each wall.
    c. Electric distribution panel: six circuits minimum, 120 volt, 60-hertz service.

11. Lighting fixtures capable of maintaining average illumination of 50 fc at desk height.
12. Furnish and equip offices as follows:

    a. Three standard size desks with three drawers each.
    b. Two plan tables: 30 by 72 by 36 inches high, with 1 equipment drawer. Locate table oriented in relation to the Site at a window with a view of the Site
    c. One metal, double-door storage cabinet under plan table.
    d. Two plan racks, each to hold a minimum of 10 racks of drawings.
    e. Five standard 4-drawer legal-size metal filing cabinets with locks and keys.
    f. Four 36 by 60 by 12 inches bookcases.
    g. Four swivel tilt chairs and three side chairs.
    h. One drafting table stool.
    i. One wastebasket per desk and table (total five).
    j. Four tack boards, 36 by 30 inches.
    k. Four task lights, swivel arm type desk mounted.
    l. Coffee machine and supplies.
    m. Telephone: four instruments; (job related long distance telephone calls shall be paid by Design Builder).
    n. Copy machine with sorter.
    o. One HP color LaserJet CM6040F multifunction printer or similar.
    p. Bottled drinking water and dispenser.
    q. Provide periodic maintenance and cleaning of furnishings, equipment, and services.
    r. Thermometer mounted at a convenient outside location not in direct sunlight.
    s. Provide one complete new set of the applicable California Building Codes and any amendments.

E. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

    1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as specified. For special areas not listed, provide fire extinguishers as required by locations and classes of fire exposures.

1. Provide hand-carried, portable UL rated, Class "A" fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers.
2. Comply with NFPA 10 and CFC Article 87 for classification, extinguishing agent and size required by location and class of fire exposure.
3. Locate fire extinguishers in field offices, storage sheds, tool houses, other temporary buildings, and throughout the Site. In the area under construction, provide at least one fire extinguisher for each 5,000 sq. ft of building floor area. Locate fire extinguishers so that a person never has to walk more than 100 feet to obtain one.

B. Heating Equipment: Unless University authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas heaters with individual space thermostatic control.

1. Use of gasoline burning or oil-fired space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to University's Representative, and marked for intended use.
3. Permanent HVAC System: If University authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of **8** at each return air grille in system and remove at end of construction.

C. Meters: For measurement of water, electricity, gas or other utilities used by Design Builder, provide meters acceptable to University's Representative for measurement of utility use.

D. Backflow preventer: Reduced Pressure Principal type.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with University's Representative and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system or University's private system as directed by University's Representative.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
2. Disinfecting: Disinfect temporary water piping prior to use.
3. Provide water meter and backflow prevention device.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of University's existing toilet facilities will not be permitted.

E. Heating and Cooling: Provide temporary heating or cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Use of University's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to University. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead, unless otherwise indicated.
2. Connect temporary service to University's existing power source, as directed by University.
3. Provide electric meter.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

I. Telephone and Electronic Communication (i.e. Data) Service: Provide temporary telephone and data service, including electronic mail, in University's field office and common-use facilities for use by all construction personnel. Install at least one telephone line(s) for each field office.

1. Provide additional telephone lines for the following:

a. Provide a dedicated telephone line for each facsimile machine in each field office.
b. Provide a dedicated telephone line for each computer in each field office.

2. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Architect's office.
e. Engineers' offices.
f. University's office.
g. Principal subcontractors' field and home offices.

3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
4. Order voice/data service through UCR Campus Communications (UCR C&C). Coordinate with UCR C&C the point of connection for said services.
a. Provide data connections as needed to Contractor's field office.
b. Provide data connection to the University Representative's trailer to accommodate each work space, computer, and equipment needs.
c. Installation shall be by a University's approved contractor.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines or existing buildings. Comply with CFC Article 87.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion may be permitted to use permanent facilities, under conditions acceptable to University.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas where possible in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas if possible.

2. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
3. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earth Moving."
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."

C. Traffic Controls: Comply with requirements of University Police or authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.
3. Traffic Control: Provide traffic control and flagman's services at all points where conveying equipment engaged on the Work regularly enters upon or crosses city, county or University maintained roads. The methods of traffic control and locations of flagman's stations shall be subject to the approval of the University's Representative.
4. Fire Access Lane: Maintain a minimum constant 24 foot wide fire truck access route at all times during construction where fire access lane is shown or required to serve existing buildings.
5. Adopt all practical means to minimize interference to traffic. Access to other University facilities in the area shall be maintained at all times.
6. Furnish all directional signage barricades, lights, and flagmen required to control vehicular, pedestrian and bicycle traffic and provide and maintain suitable temporary barricades, fences, directional signs, or other structures as required for the protection of the public; and maintain, from the beginning of twilight through the whole of every night on or near the obstructions, sufficient lights and barricades to protect the public and Work.
7. Install and maintain such devices that are necessary to provide reasonably safe passage for the traveling public, including pedestrians and bicyclists around the project, as well as for the safeguard of workers.

D. Parking: Use designated areas of University's existing parking areas for construction personnel. Provide transportation as required to and from the project site to off project site lay down area or remote construction parking lot (if provided). Coordinate specific locations with University Representative.

E. Dewatering Facilities and Drains: Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or University Facilities nor endanger permanent Work or temporary facilities.

F. Project Identification Signs: Provide Project identification signs. Install signs where directed by the University's Representative to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.
3. Provide two project identifications signs in accordance with Campus Standard detail.
4. Provide signs for traffic direction and warnings such as "Construction Project" and "Keep Out" to facilitate control of personnel and vehicles. Use only the minimum number necessary, to 2' x 4' maximum size.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of the University's Representative and authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements. Follow Best Management Practices for Solid Waste Management.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
2. Crane Operation, Staging and Storage

    a. Operator Training and Crane Certification: Prior to starting crane operations, provide copies of operator's training and crane certification to the University's Representative.
    b. Crane Staging Area: Crane staging areas will be required to be coordinated with the University's Representative a minimum of 5 business days in advance of loading and removal of crane and/or materials from the roof.
    c. Storage: will not be allowed on-project site except at remote staging areas.

I. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

K. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

L. Scaffolding: Provide scaffolding as required to complete the Work. Coordinate platform elevations and tower locations with the building design to permit Work to be conducted in accordance with the requirements for joints, changes in materials, and application of materials.

M. Temporary Shoring: Provide temporary shoring as required to protect existing buildings, utilities and other improvements that will be affected by construction activities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and follow Best Management Practices that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects to the project site, lay down area, remote contractor parking and temporary trailer facilities.

B. Temporary Erosion and Sedimentation Control: Apply Best Management Practices (BMPs) to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Stormwater Control: Comply with SWRCB and apply Best Management Practices (BMPs). Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains. These provisions are also required at off project site lay down areas.

D. Tree and Plant Protection: Comply with requirements below or as specified in Division 32 Section "Temporary Tree and Plant Protection."

1. Preserve and protect existing trees and plants at Site, which are designated to remain, and those adjacent to Site.
2. Consult with University's Representative and remove agreed-on roots and branches, which interfere with construction. Employ qualified tree surgeon to remove, and to treat cuts.
3. Protect root zones of trees and plants:

    a. Do not allow vehicular traffic or parking.
    b. Do not store materials or products.
    c. Prevent dumping of refuse or chemically injurious materials or liquids.
    d. Prevent formation of puddles or continuous running water.

4. Carefully supervise excavating, grading, filling, and subsequent construction operations, to prevent damage.
5. Replace, or suitably repair, trees and plants designated to remain which are damaged or destroyed due to construction operations.
6. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for University. Perform control operations lawfully, using environmentally safe materials.

Construction activities shall not produce stagnant water ponds conducive to mosquito breeding habitat at any time.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily seeing through and entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations and as indicated on Drawings or approved by the University's Representative.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide University with one set of keys or install University's padlock and daisy chain padlocks to allow either University or Design Builder to enter site.
3. Provide breakaway gates for fire department access in accordance with state fire authority requirements.

G. Security Cameras: Install sufficient video surveillance to prevent vandalism. Use of project progress video camera mounted on MS&E may be used as part of this system.

H. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction, unsecured existing buildings and tunnel construction openings. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed provide lighting, including flashing red or amber lights.

J. Comply with SCAQMD regulations for grading phase, including Rule 403 and Rule 402, the Nuisance Rule. To ensure that construction trucks do not emit fugitive dust and that there is no nuisance impact off the site, the contractor shall as a minimum do the following:

1. Moisten soil more than 15 minutes prior to moving soil or conduct whatever watering is necessary to prevent visible dust emissions from exceeding 100 feet in any direction
2. Apply chemical stabilizers to disturbed surface areas (completed grading areas) within five days of completing grading or apply dust suppressants or vegetation sufficient to maintain a stabilized surface.
3. Water open storage piles hourly or cover with temporary coverings.
4. Water exposed surfaces at least twice a day under calm conditions and as often as needed on windy days when winds are less than 25 miles per day or during very dry weather in order to maintain a surface crust and prevent the release of visible emissions from the construction site.
5. Wash mud-covered tires and under-carriages of trucks leaving construction sites.

6. Provide for street sweeping, as needed, on adjacent roadways to remove dirt dropped by construction vehicles or mud, which would otherwise be carried off by trucks departing project sites.
7. Securely cover loads of dirt with a tight fitting tarp on any truck leaving the construction sites to dispose of excavated soil.
8. Cease grading during periods when winds exceed 25 miles per hour.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

1. Where heating or cooling is needed and permanent enclosure is not complete provide temporary weather tight enclosure for building exterior.

L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by University and tenants from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
2. Construct dustproof partitions with 2 layers of 3-mil polyethylene sheet on each side. Cover floor with 2 layers of 3-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.

    a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water- dampened foot mats in vestibule.

3. Insulate partitions to provide noise protection to occupied areas.
4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
5. Protect air-handling equipment.
6. Weather strip openings.
7. Provide walk-off mats at each entrance through temporary partition.

M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with CFC Article 87.

1. UCR is a non-smoking campus.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

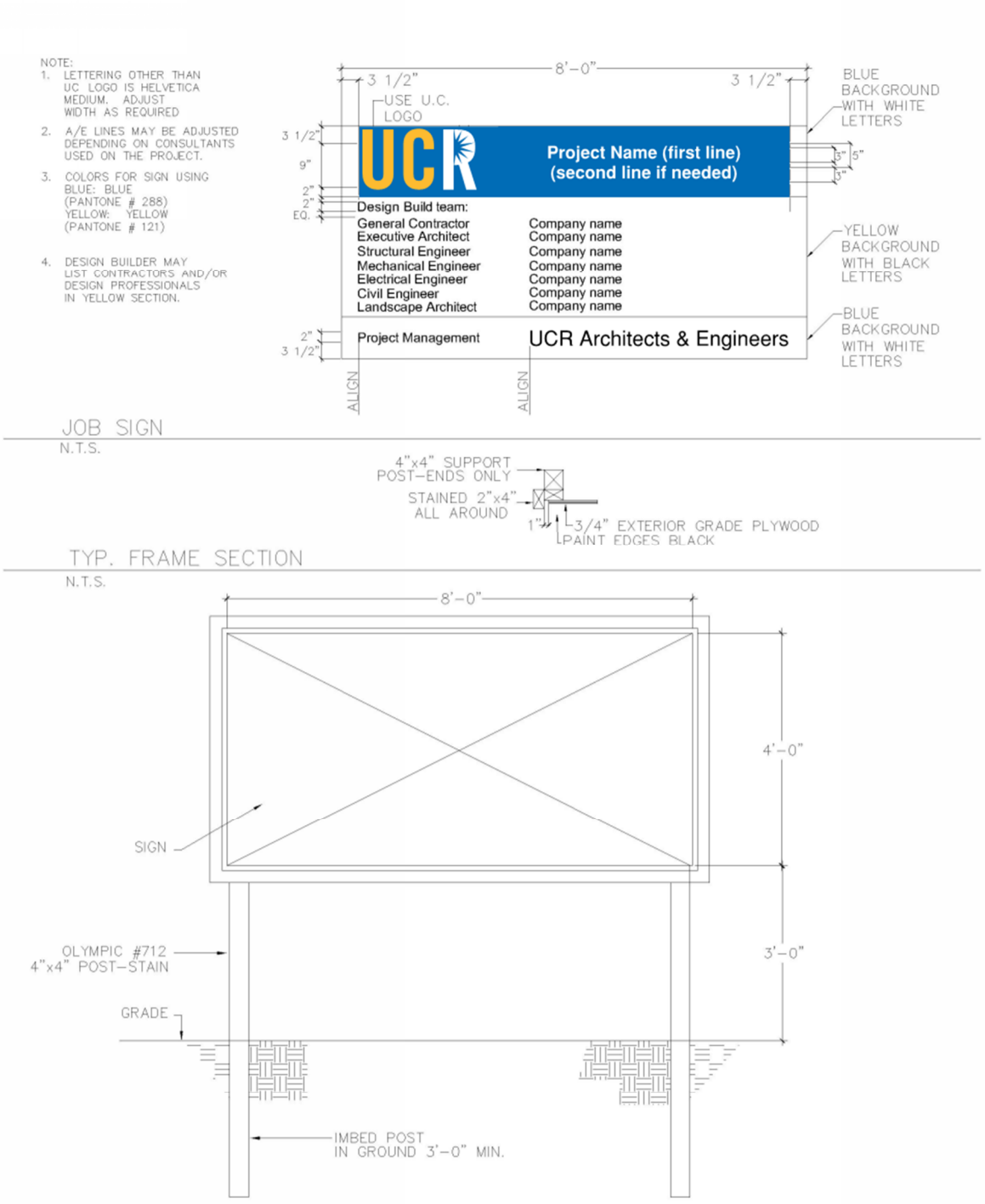
B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Design Builder. University reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by University's Representative.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."



2015 12 18 Date	University of California Riverside Architects & Engineers Campus Standard & Design Criteria Project Name	PROJECT SIGN FOR DESIGN BUILD Sheet Title	01 5000-01 Sheet No.
NO SCALE Scale			

END OF SECTION 01 5000

SECTION 01 5639 - TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the protection and trimming of existing trees that interfere with, or are affected by, execution of the Work, whether temporary or permanent construction.

B. Related Sections include the following:

1. Division 01 Section "Summary" for limits placed on Design Builder's use of the site.
2. Division 01 Section "Temporary Facilities and Controls" for temporary tree protection.
3. Division 31 Section "Site Clearing" for removal limits of trees, shrubs, and other plantings affected by new construction.
4. Division 31 Section "Earth Moving" for building and utility trench excavation, backfilling, compacting and grading requirements, and soil materials.
5. Division 32 Section "Plants" for tree and shrub planting and transplanting, tree support systems, and soil materials.

1.2 DEFINITIONS

A. Tree Protection Zone: Area surrounding individual trees or groups of trees to remain during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

D. Maintenance Recommendations: From a qualified arborist, for care and protection of trees affected by construction during and after completing the Work.

1.4 QUALITY ASSURANCE

A. Tree Service Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site on a full-time basis during execution of the work.

B. Arborist Qualifications: An arborist certified by the International Society of Arboricul- ture.

C. Tree Pruning Standard: Comply with ANSI A300, "Tree, Shrub, and Other Woody Plant Maintenance--Standard Practices" unless more stringent requirements are indicated.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before starting tree protection and trimming, meet with University's Representa- tive and other concerned entities. Review tree protection and trimming procedures and responsibilities. Notify participants at least five working days before conven- ing conference. Record discussions and agreements and furnish a copy to each participant.

PART 2 - PRODUCT

2.1 MATERIALS

A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, Size 24, with 90 to 100 percent passing; a 2-1/2-inch sieve and not more than 10 percent passing a 3/4 inch sieve.

B. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with ASTM D 5268. Provide topsoil that is free of stones larger than 1 inch in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from welldrained sites where soil occurs in depth of 4 inches or more; do not obtain from bogs or marshes.

C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

D. Chain-Link Fence: Metallic-coated steel chain-link fence fabric, 0.120-inch- diameter wire size and a minimum of 48 inches high; with 1.9-inch- diameter line posts; 2-3/8- inch-diameter terminal and corner posts; 1-5/8-inch- diameter top rail and 0.177-inch- di- ameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a com-

plete fence system. E. Organic Mulch: Ground or shredded bark, free of deleterious materials.

PART 3 - EXECUTION

3.1 PREPARATION

A. Temporary Fencing: Install temporary fencing outside tree protection zones to protect remaining trees and vegetation from construction damage. Maintain temporary fence and remove when construction is complete.

1. Install chain-link fence according to ASTM F 567 and manufacturer's written instructions.

B. Protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.

C. Do not store construction materials, debris, or excavated material inside tree protection zones. Do not permit vehicles or foot traffic within tree protection zones; prevent soil compaction over root systems.

D. Do not allow fires under or adjacent to remaining trees or other plants.

3.2 EXCAVATION

A. Install shoring or other protective support systems to minimize sloping or benching of excavations.

B. Do not excavate within tree protection zones.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.

1. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction.
2. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

D. Where utility trenches are required within tree protection zones, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.

1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

A. Grade Lowering: Where new finish grade is below existing grade around trees, slope grade away from trees as recommended by qualified arborist.

1. Root Pruning: Prune tree roots exposed during grade lowering. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots with sharp pruning instruments; do not break or chop.

B. Minor Fill: Where existing grade is 6 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required fin- ish elevations.

C. Moderate Fill: Where existing grade is more than 6 inches but less than 12 inches below elevation of finish grade, place drainage fill, filter fabric, and topsoil on existing grade as follows:

1. Carefully place drainage fill against tree trunk approximately 2 inches above elevation of finish grade and extend not less than 18 inches from tree trunk on all sides. For balance of area within drip-line perimeter, place drainage fill up to 6 inches below elevation of grade.
2. Place filter fabric with edges overlapping 6 inches minimum.
3. Place fill layer of topsoil to finish grade. Do not compact drainage fill or topsoil. Hand grade to required finish elevations.

3.4 TREE PRUNING

A. Prune remaining trees affected by temporary and new construction.

B. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by qualified arborist.

C. C. Pruning Standards: Prune trees according to ANSI A300 as follows:

1. Type of Pruning: Crown Cleaning.

2. Type of Pruning: Crown thinning.
3. Type of Pruning: Crown raising.
4. Type of Pruning: Crown reduction.
5. Type of Pruning: Vista pruning.
6. Type of Pruning: Crown restoration.

D. Cut branches with sharp pruning instruments; do not break or chop.

E. Chip branches removed from trees unless otherwise approved by the University's Representative.

3.5 TREE REPAIR AND REPLACEMENT

A. Promptly repair trees damaged by construction operations within 24 hours. Treat dam- aged trunks, limbs, and roots according to written instructions of the qualified arborist.

B. Remove and replace dead and damaged trees that the qualified arborist determines to be incapable of restoring to a normal growth pattern.

1. Provide new trees of the same size and species as those being replaced for trees less than 6 inch caliper size; plant and maintain as specified in Division 32 Section "Plants."
2. Provide new trees of 6-inch caliper size and of a species selected by University's Representative when damaged trees more than 6 inches in caliper size, measured 12 inches above grade, are required to be replaced.

C. Aerate surface soil, compacted during construction, 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.6 DISPOSAL OF WASTE MATERIALS

A. Burning is not permitted.

B. Disposal: Remove excess excavated material, displaced trees and chip from University property and legally disposed of at Design Builders' expense.

END OF SECTION 01 5739

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and product substitutions.

B. Related Sections include the following:

1. Division 01 Section "Allowances" for products selected under an allowance.
2. Division 01 Section "Alternates" for products selected under an alternate.
3. Division 01 Section "References" for applicable industry standards for products specified.
4. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
5. Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Design Builder.

1. The following are not considered substitutions:

a. Revisions to Contract Documents requested by the University's Representative.
b. Specified options of products and construction methods included in Contract Documents.
c. The Design Builder's determination of and compliance with governing regulations and orders issued by governing authorities.

1.3 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Design Builder's Contract Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:

a. Specification Section number and title.
b. Generic name used in the Contract Documents.
c. Proprietary name, model number, and similar designations.
d. Manufacturer's name and address.
e. Supplier's name and address.
f. Installer's name and address.
g. Projected delivery date or time span of delivery period.
h. Identification number on Contract Schedule network.
i. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit electronic copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
4. Completed List: Within 60 days after date of commencement of the Work, submit electronic copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
5. University's Action: University will respond in writing to Design Builder within 14 days of receipt of each product list. University's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. University's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit electronic copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form provided by University.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified material or product cannot be provided.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by University and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes

such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of Owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to University's Representative.
i. Detailed comparison of Design Builder's Contract Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Design Builder's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Design Builder's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. University's Action: If necessary, University will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. University will notify Design Builder of acceptance or rejection of proposed substitution within 21 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

   a. Form of Acceptance: signed Substitution Request form indicating acceptance from University's Representative.
   b. Use product specified if University cannot make a decision on use of a proposed substitution within time allocated.
   c. If the University's Representative determines the proposed substitution is unacceptable, then the specified material, product or equipment shall be provided.
   d. The decision of the University's Representative is final.

4. **Do not use Submittal Transmittal form with a Substitution Request form**. Substitution shall be submittal separate from submittals with the Substitution Request form as the cover sheet. Any substitutions submittal with general submittal may be rejected without review.

1.4 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

B. Compatibility of Options: If Design Builder is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

C. If the proposed substitution requires that portions of the Work be redesigned or removed in order to accommodate the substituted item, submit design and engineering calculations prepared by a California licensed design professional.

D. Samples may be required for substitutions. Tests required by University's Representative for the determination of quality and utility shall be made by Design Builder's Testing Laboratory and at the expense of Design Builder, with acceptance of the test procedure first given by University's Representative.

E. In reviewing the supporting data submitted for substitutions, University's Representative will use, for purposes of comparison, all the characteristics of the specified material or equipment as they appear in the manufacturer's published data even though all the characteristics may not have been particularly mentioned in the Specifications. If more than two submissions of supporting data are required, the cost of reviewing the additional supporting data shall be borne by Design Builder; and University will deduct the costs from the Contract Sum.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Reject delivery of damaged or defective items. Promptly remove damaged or defective products from the Project site and replace with new at no change in Contract Sum.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store sand, rock, or aggregate materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
6. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
7. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
8. Protect stored products from damage.
9. Periodically inspect stored products to assure that products are maintained under specified conditions and are free from damage and deterioration.

D. Imported Materials and Products:

1. Imported materials and products require special handling in shipping crates. Document and examine materials at the following points:

    a. At the origination point prior to crating.
    b. At the port of embarkation (for damage to crates).
    c. At the port of entry (for damage to crates).
    d. Immediately following delivery to the Site.

2. If crates show signs of damage, open them and inspect materials and products.
3. Reject damaged or defective products or materials, and replace promptly.
4. Provide detailed Bill of Goods at each point listed above, indicating quantity and condition of each item. At port locations, Bill of Goods may be accepted unless damage is observed.
5. Imported materials and products may contain hazardous materials not allowed in the United States. Provide certification that materials and products do not contain any hazardous materials banned by the Environmental Protection Agency (EPA), such as asbestos, lead paint, PCB, etc.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Design Builder of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to University.

2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for University.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. University reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," University will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is University's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. “Or Equal”: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Part 2 "Product Substitutions" Article to obtain approval for use of an unnamed product.
8. Products shall not contain any hazardous materials banned by the Environmental Protection Agency (EPA), such as asbestos, lead paint, PCB, etc.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, and indicates “no known equal” provide the named product that complies with requirements.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, and indicates “no known equal” provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Visual Matching Specification: Where Specifications require matching an established sample, select a product that complies with requirements and matches University's sample. University's decision on whether a proposed product matches will be final.

    a. When approval of a color, pattern or texture sample match by the University is required, provide the best match that complies with the specification and also provide the two nearest in the selection range to either direction from the same manufacturer/supplier. Application examples are:

        1) Color – shall have two color hues or shades darker and two color hues or shades lighter. Total of five selections available.
        2) Pattern – shall have two patterns that are less dense (or smaller) and two patterns that are more dense (or larger). Total of five selections available.
        3) Texture – shall have two textures that are less rough (or smaller) and two patterns that are more rough (or larger). Total of five selections available.

    b. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Article 2.2, Product Substitutions, for proposal of product.

6. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, University will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, University will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: University will consider requests for substitution if received within 90 days after the Phase 3 Notice to Proceed. Requests received after that time may be considered or rejected at discretion of University.

B. Conditions: University will consider Design Builder's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, University will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers University a substantial advantage in cost, time, energy conservation, or other considerations.
2. Requested substitution is consistent with the Contract Documents and will produce required results.
3. Substitution request is fully documented and properly submitted.
4. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
5. And one or more of the following conditions are satisfied:

    a. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
    b. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
    c. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Design Builder certifies that the substitution will overcome the incompatibility.
    d. The specified product or method of construction cannot be coordinated with other materials, and where the Design Builder certifies that the proposed substitution can be coordinated.
    e. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Design Builder certifies that the proposed substitution can provide the required warranty.
    f. The specified product or material has been discontinued or is no longer available.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Utility Shutdown Requirements
2. Construction layout.
3. Field engineering and surveying.
4. General installation of products.
5. Coordination of University-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of University-accepted deviations from indicated lines and levels, and final cleaning.

1.2 UTILITY SHUTDOWN REQUIREMENTS

A. General:

1. The coordination of Utility Shutdowns has become increasingly complex at UCR due to the increase and complexity of construction activity and the effect utility shutdowns have on surrounding people, buildings and facilities. By nature, utility shutdowns affect a variety of stakeholders, including students, faculty, researchers, administration, pedestrians, security and law enforcement personnel, and various departments (Communications, Information Technology, Operations and Maintenance of Plant (OMP), Building Maintenance and Custodial Services, etc.), as well as the surrounding general public. Impacts to life safety and security systems, as well as automatically and mechanically controlled climate systems on campus, are particularly critical when considering utility shutdowns. To minimize negative impacts, UCR has developed procedures and guidelines for design builders, design professionals and contractors to use when planning for and requesting a utility shutdown on all construction projects.

2. Contractor requested Utility shutdowns are discretionary on UCR's part. Not until UCR has reviewed the utility shutdown request application, and has been fully apprised of the potential risks and impacts, and any necessary contingency plans, will the Utility Shutdown Request (USR) be granted. It shall be the sole responsibility of the contractor to provide the above information, in accordance with the provisions in this section. This procedure and protocol, as well as all associated forms and schedules, in addition to the information requested herein, shall be included in the Division 1 section of the project specifications manual for each project. A copy of the final approved Utility Shutdown Plan shall be included in the 100% Construction documents record documents.
3. The procedures and guidelines provided herein may be changed at any time by UCR for security and safety reasons.

B. Protocols for tenant improvement projects within an existing building

1. Utility Shutdowns are defined as a singular event; one turn-off/one turn-on.
2. Generally speaking, shutdowns should occur during a maximum of a four hour window on weekends and/or during the hours of 12 am and 5 am within a 24 hour period, unless otherwise approved by UCR.
3. One USR is required for each 24 hour period, even if the preceding shutdown is being duplicated.
4. Contractors shall follow UCR "Lockout/Tagout" procedures. An approved "Lock Out/Tag Out" program and confined space program, reviewed by UCR EHS, shall be detailed and included for all Electric Panels and circuitry, and/or any other utility service which is being worked on or any confined space and included in a project. This program information shall be included in all USR related documentation provided by the Design Builder. All parties involved in the lockout/tagout process, such as, contractor, subcontractors, UCR Operations and Maintenance of Plant, should apply their own locks and tags. No shared lock is allowed at any time.
5. A single USR form is required for the physical shutdown of a single utility. If, by shutting down one utility, this causes loss of other systems or utilities, those other systems and utilities are identified and addressed in the Impact Analysis. For example; a shutdown of electrical may cause the loss of the Fire Alarm. The loss of the Fire Alarm is addressed as an impact.
6. A USR is required for the physical shutdown of each utility even when occurring during the same time period. For example, if both electrical and water are proposed to be shut down during a given period, two URS Forms are required. Each utility shutdown will result in different impacts, likely independent of the other, and therefore will undergo independent evaluations and approvals.
7. Utility Shutdown Request (USR) must be submitted 30 calendar days prior to the proposed utility shutdown, unless otherwise required or authorized by UCR. In the event that there is an "immediate" or "emergency" utility shutdown which must occur with less than a 30 day notice, then UCR Project Manager shall be notified with as much time as possible with all required details and impacts included in the request. UCR Staff will assist in this request as quickly as possible however no shutdown will be approved until all documents and review are completed.

8. USR's are submitted electronically or manually, including all required documentation, and they are to be included in the project specifications for each specific Capital Programs project.
9. Status of each USR review is available from the Project Manager (PM) for each project.
10. Only UCR Operations and Maintenance of Plant (OMP) personnel are permitted to disrupt or disconnect any utility system.
11. Personnel required to be at all shutdowns include the Operations and Maintenance of Plant (OMP) personnel, who will be conducting the actual shutdown; the UCR Contractor of Record; as well as Architects & Engineers (A&E) inspectors. In addition, shutdowns may require other A&E Staff, UCR Environmental Health & Safety, UCR Police Department, and UCR subcontractors. All other resources necessary for the successful shutdowns and restoration are provided by the Contractor at the time of the Shutdown and turn- on of utilities.
12. Only one primary switchboard is to be shutdown at any given time.
13. Electrical shutdowns may be required to be scheduled at a minimum of three days apart.
14. A utility shutdown may be canceled the night of the shutdown for any of the following reasons:
    a. All elements identified in contingency plan are not in place;
    b. Contractor is not ready within 30 minutes of scheduled shutdown;
    c. Security and operational readiness issues identified by UCR Staff;
15. If a shutdown is canceled for any reason, the Project Manager (PM) and Construction Inspector of Record (CIOR) shall be contacted immediately, by the person or entity cancelling the shutdown. The Project Manager and Construction Inspector of Record will then notify all stakeholders of the cancelation.

C. Protocols for new building construction projects

1. Utility Shutdowns are defined as a singular event; one turn-off/one turn-on.
2. Generally speaking, shutdowns affecting adjacent facilities should occur during a maximum of a four hour window on weekends and/or during the hours of 12 am and 5 am within a 24 hour period, unless otherwise approved by UCR.
3. One USR is required for each service being disrupted.
4. Contractors shall follow UCR "Lockout/Tagout" procedures for any utility affecting facilities "downstream" of the service. This program information shall be included in all USR related documentation provided by the Design Builder. All parties involved in the lockout/tagout process, such as, contractor, subcontractors, UCR Operations and Maintenance of Plant, should apply their own locks and tags. No shared lock is allowed at any time.
5. A single USR form is required for the physical shutdown of a single utility. If, by shutting down one utility, this causes loss of other systems or utilities, those other systems and utilities are identified and addressed in the Impact Analysis.
6. A USR is required for the physical shutdown of each utility even when occurring during the same time period. For example, if both electrical and water are proposed to be shut down during a given period, two URS Forms are required. Each utility shutdown will result in different impacts, likely independent of the other, and therefore will undergo independent evaluations and approvals.
7. Utility Shutdown Request (USR) must be submitted 14 calendar days prior to the proposed utility shutdown, unless otherwise required or authorized by UCR. In

the event that there is an "immediate" or "emergency" utility shutdown which must occur with less than a 14 day notice, then UCR Project Manager shall be notified with as much time as possible with all required details and impacts included in the request. UCR Staff will assist in this request as quickly as possible however no shutdown will be approved until all documents and review are completed.

8. USR's are submitted electronically or manually, including all required documentation to the project's University's Representative.
9. Status of each USR review is available from the Project Manager (PM) for each project.
10. Only UCR Operations and Maintenance of Plant (OMP) personnel are permitted to disrupt or disconnect any utility system.
11. Personnel required to be at all shutdowns include the Operations and Maintenance of Plant (OMP) personnel, who will be conducting the actual shutdown; the Design-build Contractor; as well as Architects & Engineers (A&E) inspectors. In addition, shutdowns may require other A&E Staff, UCR Environmental Health & Safety, UCR Police Department, and UCR subcontractors. All other resources necessary for the successful shutdowns and restoration are provided by the Design-build Contractor at the time of the Shutdown and turn-on of utilities.
12. Electrical shutdowns may be required to be scheduled at a minimum of three days apart.
13. A utility shutdown may be canceled the night of the shutdown for any of the following reasons:
    a. All elements identified in contingency plan are not in place;
    b. Contractor is not ready within 30 minutes of scheduled shutdown;
    c. Security and operational readiness issues identified by UCR Staff;
14. If a shutdown is canceled for any reason, the Project Manager (PM) and Construction Inspector of Record (CIOR) shall be contacted immediately, by the person or entity cancelling the shutdown. The Project Manager and Construction Inspector of Record will then notify all stakeholders of the cancelation.

D. UCR Roles and Responsibility

1. UCR Operations and Maintenance of Plant (OMP) (performs ALL shutdowns): (OMP) is a division within the Business and Administrative Services (BAS) and is the ONLY party allowed to physically disrupt or disconnect any utility system. The role of (OMP) is to provide maintenance of the overall University facility. Utility shutdowns will be scheduled based on availability of those resources, while recognizing that it will be necessary to schedule those required resources, and calculate all fees for the service as early as is possible.
2. UCR A&E, Construction Inspector of Record (CIOR) (participants on ALL shutdowns): UCR Inspectors will be present at the beginning, periodically during and at the end of all utility shutdowns and turn-on events. Inspections shall certify that the utility has been re-established satisfactorily and (CIOR) will document the same. UCR EH&S shall communicate UCR lockout/tagout procedures with the Contractor.
3. UCR A&E, Project Manager (PM) (participant in ALL shutdowns): The designated Project Manager is the single point of contact for the Contractor for all utility shutdowns. The PM has the initial responsibility to approve and/or

reject the USR and, with others, will review the Contractors implementation of the Contingency Plan and proposed execution of the utility shutdown and may be at the site at the time of shutdown and/or turn-on.

E. Design Builder Roles and Responsibilities

1. Design Builder shall submit a detailed Utility Shut Down Plan which shall identify all of the utilities affected, how the utility is to be isolated, maximum allowable duration of interruption (if applicable) and the affected facilities and systems, and lockout/tagout procedures for all shut downs. The Design Builder is responsible for submitting a Utility Shutdown Request (USR) for each and every proposed utility shutdown event.
2. Design Builder is responsible for developing the Impact Analysis to be included with the USR. The Impact Analysis must include the specific location of the utility shutdown, documentation of field forensic investigations to verify as-built conditions and all systems and parties affected by the shutdown, lockout/tagout procedures, and the specific impact to each system and party affected. Documentation can include written narrative, diagrams, sketches, and photos as appropriate. The Impact Analysis shall include a specific work plan for providing contractor personnel and equipment to support the shutdown, including requirements generated by the impacts to other systems and parties. The Impact Analysis must also identify the need for support from other entities such as UCR Communication and Computer Systems Services, UCR OMP, UCR EH&S, UCR Police Department, UCR Subcontractors, and others. Early notice is imperative for proper coordination.
3. Emergency Shutdown events will be handled on a case by case basis, however as much prior notice as possible shall be provided to the Project Manager. Immediately notify the Project Manager if/when this occurs. Only UCR A&E team members in conjunction with OMP shall decide if the event is an “emergency”.
4. In communication with the Project Manager for the specific project, the Design Builder shall meet with all Shutdown Stakeholders in order to address/mitigate fully, all comments or concerns raised by the utility shutdown activity. The Project Manager will coordinate this meeting.
5. Once all comments and issues are discussed and addressed, and/or the initial Utility Shutdown Plan is approved, the Design Builder will correct and re-submit all Utility Shutdown Plan documents to the Project Manager for inclusion in the Construction Documents and Project Specifications Manual.
6. Design Builder shall prepare all Utility Shutdown forms.
7. Design Builder shall ensure that all Construction Documents are updated so that final “As-Built” documents reflect all Utility Shutdown activity for this project.
8. Design Builder is responsible for developing and implementing a contingency plan, if requested by UCR, to mitigate specific impacts during the shutdown. Any and all resources, including equipment, manpower and supervision required for the execution of the contingency plan are the responsibility of the Design Builder. This includes, but is not limited to, temporary signage, temporary power, clean-up of collateral damage, operational workarounds, etc. This may include all areas and systems impacted by the shutdown.
9. The Design Builder is responsible for issuing a monthly 30 day look-ahead calendar that includes the identification of all projected USR’s. The calendar

shall be updated as necessary and shall identify the contractor's utility shutdown identification/number (CUSR) and the date and type of the proposed shutdown.

10. During the utility shutdown, the Design Builder is responsible for documenting previously unknown conditions found at the shutdown location, and for including them within the official project construction documents for permanent archiving with the Architects & Engineers Office.
11. The Contractor is responsible for contacting the Project Manager at least 2 hours prior to the actual utility shutdown and prior to the utility restart. If there is any delay in the shutdown or restart from the approved schedule, the Contractor is responsible for notifying the PM as soon as that information is known.

F. Process and Procedure for submitting USP and USR's

1. The Design Builder shall submit the initial detailed Utility Shutdown Plan (USP), which includes and identifies all utilities affected, how the utility is to be isolated, maximum allowable duration of interruption (if applicable) and the affected facilities, and lockout/tagout procedures for all major shut downs. Design Builder shall also specify by-pass or temporary service if required to minimize disruption to the University. A copy of the approved plan, which includes the prepared Utility Shutdown Request (USR), will be included in the record documentation.
2. The Design Builder submits the project USR, in electronic or hard copy format, including the Impact Analysis (mandatory), to the University's Representative Project Manager. This starts the required calendar day review period necessary for processing the USR. Any revisions or additions to the submitted USR, necessitating the re-submittal of the USR, will result in the restart of the required calendar day review period.
3. The University's Representative Project Manager will review the submitted USR for need, completeness, and compliance with the required notification period. Any changes to the USR or Impact Analysis along with any requirement for a contingency plan will be transmitted by the University's Representative Project Manager to the Design Builder. The PM will provide the initial approval of the USR.
4. Following the initial approval by the PM the USR, Impact Analysis, and Contingency Plan (if required) will be reviewed by Physical Plant (OMP), Environmental Health & Safety (EH&S) and other stakeholders. This review will include a technical review of the Impact Analysis, by impacted stakeholders, and coordination of schedule for the utility shutdown.
5. Upon a satisfactory review of the USR, including the Impact Analysis and Contingency Plan, the PM will schedule a Stakeholder Coordination Meeting, if needed. This meeting is chaired by the PM and includes the Contractor and all applicable stakeholders identified in the USR or as part of the review process. The purpose of the meeting is to review all elements of the utility shutdown including the review of impacts and applicable contingencies to assure all known elements have been addressed. The USR and applicable Contingency Plan can be modified in this meeting provided all stakeholders are in agreement, the modification does not impact any additional stakeholder not in attendance, and the resulting shutdown in the field can be fully supported.
6. Upon satisfactory completion of the Stakeholder Coordination Meeting, the PM will obtain final approval signatures.

7. The PM will return the approved (USR) to the Contractor with copies to all stakeholders identified in the (USR) as well as other parties identified by the UCR Staff.
8. Following approval of a (USR), if the (USR) is cancelled for any reason, the PM will immediately notify all stakeholders of the cancellation.

1.3 SUBMITTALS

A. Qualification Data: For land surveyor or professional engineer.

B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

C. Certified Surveys: Submit three copies signed by land surveyor or professional engineer and one AutoCad electronic file of survey on CD-R.

D. Final Property Survey: Submit three copies showing the Work performed and record survey data and one AutoCad electronic file of survey on CD-R.

E. Contingency Plan: Submit six copies within 60 days of Notice to Procedure for emergency plan(s) should an existing utility be damaged.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in California and who is experienced in providing land-surveying services of the kind indicated.

B. If cleaning and protection is not performed to the satisfaction of the University's Representative, the University reserves the right to have cleaning performed by others at the Design Builder's expense.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3. Locate all known existing utilities and shut-off devices before proceeding with construction operations which may cause damage to such installations. Existing utilities shall be kept in service where possible and damage to them shall be repaired with no adjustment of Contract Sum.
4. If any other structures or utilities are encountered, request University's Representative to provide direction on how to proceed with the Work.
5. If any structure or utility is damaged, take appropriate action to ensure the safety of persons and property.
6. Submit a contingency plan for emergency repair of all utilities to University's Representative for approval prior to commencing Work.

B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

    a. Description of the Work.
    b. List of detrimental conditions, including substrates.
    c. List of unacceptable installation tolerances.
    d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with University's Representative.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to University's Representative. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on Form, "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify University's Representative promptly.

B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify University's Representative when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by University's Representative.

3.4 FIELD ENGINEERING

A. Identification: University will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of University's Representative. Report lost or destroyed

permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to University's Representative before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation.

1. Make vertical work plumb and make horizontal work level.
2. Install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Doors and access panels shall be kept clear.
5. Before beginning any installation, make provisions to avoid interference.
6. Relocate installed work that does not provide adequate accessibility.
7. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
8. Do not obstruct spaces and installations that are required to be clear by California Building Codes requirements.

B. Precedence of Installation Requirements:

1. Descriptive specification.

2. Product listing, classification or certification.
3. Manufacturer's installation instructions.
4. Trade association or referenced standards.
5. Most common trade practice.

C. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated unless more explicit or stringent requirements are contained in contract documents.

D. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

E. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

1. Maximum noise level for trenchers, graders, and trucks shall not exceed 90 dBA at 50 feet as measured under the noisiest operating conditions. For other equipment, noise levels shall not exceed 85 dBA at 50 feet.
2. Jack hammers shall be equipped with exhaust mufflers and steel muffing sleeves. Air compressors should be of a quiet type such as a "wisperized" compressor.
3. Machines and equipment shall not be left idling.
4. Electric power shall be used in lieu of internal combustion engine power wherever possible.
5. Schedule noisy operations so as to minimize their duration at any given location
6. Equipment shall be properly maintained to reduce noise from excessive vibration, faulty mufflers, or other sources.
7. Provide noise barriers to comply with above criteria.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application and as required by Applicable Code Requirements for accessibility. Refer questionable mounting height decisions to the University's Representative for final decision.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

4. Comply with the California Building Code requirements for earthquake Seismic Zone 4.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, produce sketch to arrange joints for the best visual effect and submit to the University's Representative for review. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

K. Isolate each part of the completed construction from incompatible material to prevent deterioration.

3.6 UNIVERSITY-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for University's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by University's construction forces.

1. Contract Schedule: Inform University of Design Builder's preferred contract Schedule for University's portion of the Work. Adjust contract Schedule based on a mutually agreeable timetable. Notify University if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include University's construction forces at preinstallation conferences covering portions of the Work that are to receive University's work. Attend preinstallation conferences conducted by University's construction forces if portions of the Work depend on University's construction.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas at frequent intervals, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in CFC Article 87 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Puncture.
12. Abrasion.
13. Heavy traffic.
14. Soiling, staining and corrosion.
15. Bacteria.
16. Rodent and insect infestation.
17. Combustion.
18. Electrical current.
19. High speed operation.
20. Improper lubrication.
21. Unusual wear or other misuse.

22. Contact between incompatible materials.
23. Destructive testing.
24. Misalignment.
25. Excessive weathering.
26. Unprotected storage.
27. Improper shipping or handling.
28. Theft.
29. Vandalism.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

C. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

EXHIBIT A – UTILITY SHUTDOWN REQUEST (USR)

UTILITY SHUTDOWN REQUEST (USR)

APPLICATION (USR)
#2015-XXXXX

Project Number: XXXXXX Contractor USR Tracking Number: _____

Construction Project Description: _____ Project Manager: _____

1. E-mail/submit one (1) form for each utility being requested for shutdown. You must fill out separate forms for each shutdown request.
2. Shutdown information times shall be in half-hour increments.
3. E-mail completed form to the Physical Plant and A&E Project Manager.
4. Requests must be received a minimum of 30 days prior to the utility shutdown event time-NO EXCEPTIONS
5. Utilities shall be shut down and restored by OMP personnel ONLY.
6. The shutdown will not occur unless the Contractor is present at the shutdown location and work area.
7. Please complete the form in its entirety including attached Impact Analysis and Impact Analysis Checklist.

INCOMPLETE FORMS WILL NOT BE PROCESSED.

NOTICE: All forms received on Saturday, Sunday or after 1:00 p.m. (Weekdays) will be marked as "RECEIVED" on the following business day.

SHUTDOWN TIMES MAY CHANGE WITHOUT NOTICE DUE TO UNIVERSITY OPERATIONAL PRIORITIES

(Select ONE utility per form)

☐ Water ☐ Electrical ☐ Gas ☐ Fire Alarm ☐ Security System

☐ Sewer ☐ Automatic Fire Sprinklers ☐ Communications ☐ HVAC ☐ Other _____

Specific Location: _____ Work Areas Adjacent To: _____.

Affected Buildings/Systems: _____

Purpose: _____

Floor Level: _____ Landside Area: _____

Building to Remain Occupied? Yes ☐ No ☐ Is this a Laboratory? Yes ☐ No ☐

CONTACT INFORMATION:

Subcontractor: _____ Contact Name: _____

Phone Number: ( ) ____ - _____ FAX: ( ) ___ - _____ E-MAIL: _____

SHUTDOWN INFORMATION: RESTORE INFORMATION:

Day: _____ Date: _____ Time: _____ Day: _____ Date: _____ Time: _____

Comments: _____

Contractor Requestor's Name: _____ Position/Title: _____

Phone: ( ) _____ E-MAIL: _____ Submitted: _____

DO NOT WRITE BELOW THIS LINE FOR UNIVERSITY OF CALIFORNIA, RIVERSIDE USE ONLY

APPROVED ☐

Date (USR) Received: _____ Time: _____ DENIED (NOT APPROVED) ☐

Comments: _____

Executive Director _____ Senior Project Manager _____

UCR-USR APPLICATION.1/1 (REV. 4/03/2013) Contractors Utility Shutdown Request- Application

UTILITY SHUTDOWN REQUEST (USR)

IMPACT ANALYSIS

Project No. _____ **Project Manager:** _____

Construction Project Description: _____

Detailed Description of Utility to be Shutdown:

Specific Location:

Lockout/Tagout :

Affected Systems/Equipment:

Impact of Work on Systems/Equipment/Stakeholders

Plan to Mitigate Impacts:

Proposed Work Plan for Implementing the Shutdown:

ATTACH DOCUMENTATION FO FIELD FORENSIC INVESTIGATION, SKETCHES, DIAGRAMS, PHOTOS, AND ADDITIONAL NARRATIVE EXPLANATION AS APPROPRIATE. PROVIDE NAME OF SPECIFIC STAKEHOLDERS IMPACTED

IMPACT ANALYSIS CHECKLIST (1 of 2)

UTILITY SHUTDOWN REQUEST

UCR Project Number: _____ A & E Project Manager: _____

Construction Project Description: _____

Utility to be shutdown: _____ Locations: _____

☐ Field Forensics Investigations and Documentation Complete Date of Completion: ____-____-____

NOTE: CONTRACTOR IS REQUIRED TO COMPLETE AND DOCUMENT FIELD FORENSIC INVESTIGATIONS TO VERIFY AS-BUILT CONDITIONS

Impacted Facilities	Yes	No	Description
Parking Structure	☐	☐	
Sports Field	☐	☐	
Student Recreation Center	☐	☐	
Laboratory	☐	☐	
Administration Building	☐	☐	
Class Rooms	☐	☐	
Streets	☐	☐	
Physical Plant (OMP)	☐	☐	
Central Plant/Steam Plant	☐	☐	
Sports Facility	☐	☐	
Other	☐	☐	

Impacted Parties (Stakeholders)	Yes	No	Description
Students	☐	☐	
Faculty	☐	☐	
Administration	☐	☐	
Vendors	☐	☐	
Other Contractors/Projects	☐	☐	
UCR Department	☐	☐	
IT/Communications	☐	☐	
Fire and Life Safety	☐	☐	
Police/Security	☐	☐	
Physical/Central Plan (OMP)	☐	☐	

Impacted Systems	Yes	No	Description
Water	☐	☐	
Sewer	☐	☐	
Electrical	☐	☐	
Fire Sprinklers	☐	☐	
Fire Alarms	☐	☐	
Gas	☐	☐	
Landscape/Water	☐	☐	
Security	☐	☐	
HVAC	☐	☐	
IT/Communications	☐	☐	
Other	☐	☐	

(Continued From Previous Page)

IMPACT ANALYSIS CHECKLIST (2 of 2)

UTILITY SHUTDOWN REQUEST

Project Number: _____ **A & E Project Manager:** _____

Construction Project Description: _____

Utility to be shutdown: _____ **Locations:** _____

☐ **Field Forensics Investigations and Documentation Complete** **Date of Completion:** _____-_____-_____

NOTE: CONTRACTOR IS REQUIRED TO COMPLETE AND DOCUMENT FIELD FORENSIC INVESTIGATIONS TO VERIFY AS-BUILT CONDITIONS

Work Plan Requirements	Yes	No	Description
Parking Structure	☐	☐	
Sports Field	☐	☐	
Student Recreation Center	☐	☐	
Laboratory	☐	☐	
Administration Building	☐	☐	
Class Rooms	☐	☐	
Streets	☐	☐	
Physical Plant (OMP)	☐	☐	
Central Plant/Steam Plant	☐	☐	
Sports Facility	☐	☐	
Other	☐	☐	

Work Plan Reviewers	Yes	No	Description-(Specific Persons who will review this Work Plan)
Students	☐	☐	
Faculty	☐	☐	
Administration	☐	☐	
Vendors	☐	☐	
Other Contractors/Projects	☐	☐	
UCR Departments	☐	☐	
IT/Communications	☐	☐	
Fire and Life Safety	☐	☐	
Police/Security	☐	☐	
Physical/Central Plan (OMP)	☐	☐	

Impacted Systems	Yes	No	Description
Water	☐	☐	
Sewer	☐	☐	
Electrical	☐	☐	
Fire Sprinklers	☐	☐	
Fire Alarms	☐	☐	
Gas	☐	☐	
Landscape/Water	☐	☐	

UTILITY SHUTDOWN (OMP)

Request for Assistance

Check Box if Meeting is Required (See Below) ☐

Project No. _____ **Project Manager:** _____

Construction Project Description: _____

Time Charged to Complete this Request for Assistance: _____

Project Manager- Detailed Description of Assistance Requested from Physical Plant (OMP):

Project Manager- Specific Location of Shutdown:

Project Manager- Affected Systems/Equipment Under Discussion:

Physical Plant (OMP) Response-Plan/Discussion to Mitigate Impacts or Proposed Work Plan for Implementing the Shutdown:

Schedule Meeting to Discuss:

ATTACH DOCUMENTATION FOR FIELD FORENSIC INVESTIGATION, SKETCHES, DIAGRAMS, PHOTOS, AND ADDITIONAL NARRATIVE EXPLANATION AS APPROPRIATE. PROVIDE NAME OF SPECIFIC STAKEHOLDERS IMPACTED

SECTION 01 7329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching work completed within a new project.

B. Related Sections include the following:
1. Divisions 02 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
2. Division 07 Section "Penetration Firestopping" for patching fire-rated construction completed within the project.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 7 calendar days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. University's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would reduce, in University's opinion, the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials. Care shall be taken to locate material ‘cut in’ in the least conspicuous area as practicable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 7329

SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:

1. Division 01 Section "Sustainable Design Requirements" for additional LEED requirements.
2. Division 01 Section "Temporary Facilities and Controls" for environmental-protection measures during construction.
3. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.
4. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.
5. Division 04 Section "Cast Stone Masonry" for disposal requirements for excess stone and stone waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of a minimum of 95 percent (Design Builder will be eligible to select LEED Credit MR 2.2) by weight of total waste generated by the Work.

1. Construction Waste:

a. Site-clearing waste.
b. Masonry and CMU.
c. Lumber.
d. Wood sheet materials.
e. Wood trim.
f. Metals.
g. Roofing.
h. Insulation.
i. Carpet and pad.
j. Gypsum board.
k. Piping.
l. Electrical conduit.
m. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
6) Wood crates.
7) Plastic pails.

1.4 SUBMITTALS

A. Waste Management Plan: Submit electronic copies of plan within 30 days of date established for the Notice to Proceed.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit three copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

H. LEED Submittal: LEED letter template for Credit MR 2.1 and 2.2 if applicable, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

I. Qualification Data: For Waste Management Coordinator.

1.5 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: LEED Accredited Professional by U.S. Green Building Council. Waste management coordinator may also serve as LEED coordinator.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by University's Representative. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for University's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to University.
4. Transport items to University’s storage area on campus as designated by University’s Representative.
5. Protect items from damage during transport and storage.

3.3 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Design Builder.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off University's property and transport to recycling receiver or processor.

3.4 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees on-site or at landfill facility.

C. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

D. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.5 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off University's property and legally dispose of them.

END OF SECTION 01 7419

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Final Inspection procedures.
2. Warranties.
3. Final cleaning.

B. Related Sections include the following:

1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 01 Section "Photographic Documentation" for submitting Final Completion construction photographs and negatives.
3. Division 01 Section "Execution Requirements" for progress cleaning of Project site.
4. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
6. Division 01 Section "Demonstration and Training" for requirements for instructing University's personnel.
7. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 FINAL PROJECT CLOSEOUT PROCEDURE

A. Completion requires a five stage Project Closeout Procedure. The following provides a description of the procedure. Included at the end of the section is a Project Closeout Procedure flow diagram.

B. Stage One:

1. Construction is complete, required inspections have been performed, and the Work approved by the Design Builder.
2. Submit maintenance and operations manuals for preliminary review a minimum of 30 days prior to submitting Request for Inspection for Substantial Completion.
3. Operating building systems have been taken through start-up and sequence of operations procedures under the direction of a startup service technician.
4. Test and balance of mechanical systems and testing of electrical, alarm and communications systems are complete.
5. Purging and sterilization of plumbing systems is complete.

6. Certification of Life Safety systems and equipment which is the Design Builder's responsible is complete.
7. State elevator safety inspector has passed each elevator.

C. Stage Two:

1. Submit required two-week advance notice of Request for Inspection for Substantial Completion.
2. Design Builder in conjunction with its Subcontractors (including design professionals and manufacturer's representatives, as appropriate) performs an independent review of the completed Work and generates a punch list of incomplete items and items requiring correction.
3. Campus Fire Marshal has completed review and approved fire safety systems.
4. Completes or corrects the items contained on Design Builder's Design Professionals and Campus Fire Marshall's punch lists.
5. Verify completion of Punch lists items.
6. Building operating systems have been maintained in continuous operation for a minimum of two weeks under the direction of startup technician.
7. Remove uninstalled building materials and tools from the building to the designated staging area and the building is broom cleaned.
8. Notify the University that the Work is complete and ready for final inspection and issuance of a Certificate of Substantial Completion.
9. Submit a schedule and agenda for each training session.

D. Stage Three:

1. Upon receipt of Design Builder's Request for Final Inspection for Substantial Completion, University's Representative will either proceed with the final inspection or advise the Design Builder of unfulfilled requirements. Final Inspection will only be performed for the project as a whole, except as otherwise directed by University's Representative.
2. When the project is deemed ready for final inspection, University's Representative and its design consultants, in conjunction with other University personnel will complete a review of the completed Work and generate a punch list of incomplete items and items requiring correction. University will be allowed 3 weeks for completion of this activity.
3. University completes certification of equipment for which it is responsible as required by the Contract Documents.
4. Within one week of receipt of the University Punch list, Design Builder shall begin correction of the items contained on the University Punch list and when completed request University back check of those items.
5. If the back check either reveals that items have been completed or that only a limited number of items remain to be completed, the University may issue a Certificate of Substantial Completion. However, if the back check reveals that a substantial number of items remain to be completed or corrected the Design Builder shall be directed to complete those items.
6. Complete remaining items and request a final back check. This process shall be repeated until University's Representative determines that the Work is complete.
7. Provide complete demonstration and training for each building operating system from start-up through sequence of operation to shutdown.

8. Discontinue and/or relocates temporary facilities (except any construction offices relocated to the interior of the building as agreed upon by the University Representative) and final construction trailer meter readings.
9. Substantial Completion will not be accepted until University's Representative receives evidence of satisfactory completion of Facility Commissioning requirements specified in Division 01 Section “General Commissioning Requirements”.

E. Stage Four:

1. Upon issuance of substantial completion request that Facilities Management complete building final meter readings for utilities, a measured record of stored fuel and any other similar data required to determine the final statement of Contract Sum.
2. Complete the minor punch list items remaining after the issuance of the Certificate of Substantial Completion.
3. The University completes a back check of each item contained on the University’s punch list. University shall be permitted a minimum of one week to complete the back check.
4. Remove construction mock-ups from the project site.
5. Complete Final Cleaning per the specifications.
6. Make submittal of final maintenance and operations manuals, final project photographs, damage or settlement surveys (as required), property survey and similar final record information.
7. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
8. Submit list of Manufacturers (Exhibit 27).
9. Submit releases required from any agency having authority over unrestricted use of the Work including access to services, utilities, operating permits, occupancy permits, etc. as may apply.
10. Submit As-Built Drawings and Specifications for University review.
11. University reviews As-Built Drawings and Specifications for completeness and correctness and returns comments to Design Builder.
12. Delivers tools, spare parts, extra stock and similar items as required by the Contract Documents to the University.
13. Deliver miscellaneous equipment, cabinets, panels, etc. keys to University’s Representative.
14. Request changeover of any remaining insurance coverage to the University as required for continuing coverage of the Work for the project.
15. University shall provide keying for building doors.
16. Make final submittal of Record Documents.

F. Stage Five:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of University's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by University’s Representative. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Request for release of retention including consent of surety to release of retention.
6. University files the Notice of Final Completion.

1.3 WARRANTIES

A. General: Guarantees from subcontractors shall not limit Design Builder's warranties and guarantees to University. Whenever possible, Design Builder shall cause warranties of subcontractors to be made directly to University. If such warranties are made to Design Builder, Design Builder shall assign such warranties to University prior to final payment.

B. Submittal Time: Submit written Guarantee Form within 10 days of the date of Substantial Completion and prior to request for final completion.

C. Warranty form: Submit written guarantees, in the form contained at the end of this section unless otherwise required in individual Sections.

D. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual. Provide two original signed copies.

1. Table of Contents: Neatly typed and in orderly sequence. Provide complete information for each item as follows:

    a. Product or Work item.
    b. Firm name, address, and telephone number; and name of principal.
    c. Scope.
    d. Date of beginning of guarantee, bond, or service and maintenance contract.
    e. Duration of guarantee, bond, or service and maintenance contract.
    f. Design Builder's name, address, and telephone number; and name of principal.

2. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, number, and name of Design Builder.

E. Provide additional copies of each warranty in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations. Those include but are not limited to South Coast Air Quality Management District (SCAQMD) and State Water Resources Control Board (SWRCB).

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in a commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.
b. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
c. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
d. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
e. Remove tools, construction equipment, machinery, and surplus material from Project site.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dirt from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean floors made of tile, VCT, stone or epoxy in accordance with the manufacturers recommendations.
i. Sweep concrete floors broom clean in unoccupied spaces.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
n. Remove paint over "UL" and similar labels, including mechanical and electrical nameplates. Replace label if damaged from cleaning.
o. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
p. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
q. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grilles.
r. Clean ducts, blowers, and coils if units were operated without filters during construction.
s. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
t. Leave Project clean and ready for occupancy.

C. Additional cleaning shall occur after completion of punch list items.

D. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report and submit to the University's Representative.

E. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in lighting fixtures to comply with requirements for new fixtures.

F. Replace parts subject to unusual operating conditions.

G. Remove any 'punch list' identifying markers (i.e. 'blue tape') after ensuring any areas earlier identified requiring remediation have been rectified.

H. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on University's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

I. Confirm by snaking or piping camera that the new and existing underground sanitary and storm drain pipes are clean of construction debris under the building and on site until a connection of a significantly larger pipe.

3.2 CONTINUING INSPECTIONS

A. Provide continuing inspections or consultations to adjust operating systems for a period listed in specific Sections.

GUARANTEE

Project: Multidisciplinary Research Building 1 Project No. 950528

Location: **University of California, Riverside** Date: _____

GUARANTEE FOR _____ (the "Contract"),
{Specification section and contract number}

between **The Regents of the University of California** ("University") and

_____ ("Design Builder").
{Name of Design Builder or subcontractor firm}

hereby guarantees to University that all materials, furnishings and equipment which we have supplied and installed are new, unless otherwise specified, and that all Work is of good quality, free from faults and defects in engineering and design, materials, construction, manufacture and workmanship, and in conformance with the Contract Documents and Construction Documents and in conformance with all applicable codes and standards.

The undersigned further agrees that, if at any time within two years after the date of Substantial Completion the undersigned receives notice from University that the aforesaid portion of the Work is unsatisfactory, faulty, deficient, incomplete, or not in conformance with the requirements of the Contract, the undersigned will, within 10 days after receipt of such notice, correct, repair, or replace such portion of the Work, together with any other parts of the Work and any other property which is damaged or destroyed as a result of such defective portion of the Work or the correction, repair, or replacement thereof; and that it shall diligently and continuously prosecute such correction, repair, or replacement to completion.

In the event the undersigned fails to commence such correction, repair, or replacement within 10 days after such notice, or to diligently and continuously prosecute the same to completion, the undersigned, jointly and severally, do hereby authorize University to undertake such correction, repair, or replacement at the expense of the undersigned; and Design Builder will pay to University promptly upon demand all costs and expenses incurred by University in connection therewith. If we fail to fulfill the preceding obligations, and if the University brings action to enforce this warranty, we agree to pay the University's attorneys' fees and expenses incurred in connection therewith, and interest at the maximum rate allowed by law. This warranty is in addition to, and not in substitution of, the rights and remedies available under the Contract Documents or pursuant to applicable law. The warranty is for the benefit of the University.

SUBCONTRACTOR

Date: _____

Signed: _____

Typed Name: _____

Title: _____

Name of Firm: _____

Contractor License Classification & No.

_____

Telephone Number: _____

Address: _____

DESIGN BUILDER

Date: _____

Signed: _____

Typed Name: _____

Title: _____

Name of Firm: _____

_____

END OF SECTION 01 7700

Project Closeout Procedure
Transfer of Capital Projects to Facilities Management

STAGE 1	STAGE 2	STAGE 3	STAGE 4		STAGE 5
DESIGN BUILDER: Submit Preliminary Maintenance And Operation Manuals	DESIGN BUILDER: Submit 2-week notice for Final Inspection	UNIVERSITY: Final Inspection & Punch List Preparation	DESIGN BUILDER: Request Final Meter Readings	DESIGN BUILDER: Submit Releases As Applicable	DESIGN BUILDER: Submit Final Pay Application
DESIGN BUILDER: Start Up Building Systems	DESIGN BUILDER: Design Builder & Design Professionals Prepare Punch List	UNIVERSITY: Equipment Certifications	DESIGN BUILDER: Complete University Punch List	DESIGN BUILDER: As Built Drawings And Specifications	DESIGN BUILDER: Submit Certified Punch List Sign-Off
DESIGN BUILDER: Submit Test And Balance Report	UNIVERSITY: EH&S & Campus Fire Marshal Review	DESIGN BUILDER: Correct University Punch List Items	DESIGN BULDER: Remove Mockups	DESIGN BUILDER: Deliver Extra Stock	DESIGN BUILDER: Submit Final Insurance Coverage
DESIGN BUILDER: Sterilize Domestic Water System	DESIGN BUILDER: Correct Punch List Items & Verify	DESIGN BUILDER: Building Systems Training Facilities Management	DESIGN BUILDER: Final Cleaning	DESIGN BUILDER: Deliver Miscellaneous Keys	DESIGN BUILDER: Submit Pest Control Report
DESIGN BUILDER: Certify Life Safety Systems	DESIGN BUILDER: Submit Training Schedule	DESIGN BUILDER: Remove Trailers from Project Site	DESIGN BUILDER: Submit Final Maintenance & Operation Manuals	DESIGN BUILDER: Change Insurance Coverage	DESIGN BUILDER: Request Release Of Retention
DESIGN BUILDER: Request State Elevator Inspection	DESIGN BUILDER: Notify University ready for Final Inspection	DESIGN BUILDER: Confirm Satisfactory Completion of Commissioning	DESIGN BUILDER: Submit Warranties & Guarantees	DESIGN BUILDER: Submit Record Drawings	UNIVERSITY: File Notice Of Final Completion

Beneficial Occupancy (UNIVERSITY OPTION)

December 18, 2015

END OF SECTION 01 7700

SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Finishes Maintenance manuals for the care and maintenance of products, materials, and finishes.
4. Operation and Maintenance manuals for systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual at least 45 days before requesting inspection for Substantial Completion. Submittal shall include a complete operation and maintenance directory. University will return one copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit two copies of each manual in final form at least 30 days before final inspection. University will return copy with comments within 15days after final inspection.

1. Correct or modify each manual to comply with University's comments. Submit four (4) copies of each corrected manual within ten (10) days of receipt of University's comments.

1.4 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Date of submittal.
4. Name, address, and telephone number of Contractor.

5. Name and address of responsible Design Professional.
6. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring"D" ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross- referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
   c. Use of photographs instead of drawings to demonstrate an unusual installation is acceptable.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.
9. Occupant stuck in elevator.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of University's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 PRODUCT FINISHES MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.

3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT OPERATION AND MAINTENANCE MANUAL

A. Manual shall be provided in the following volumes to match the department. Some information shall be provided in more than one volume. Final contents shall be as directed by the University's Representative. The following list may not include all equipment on the project.

1. Volumes shall be:

No.	Department	Description of contents
1	BUILDING ENGINEER	Air handling Units Fan coil units Hydronic specialties Steam specialties Pumps (hydronic, fire & domestic booster) Vacuum Pumps Air Compressors Soft Water, D.I., R.O. systems Heat Exchanger DHW Generators Filters Emergency Generators Boilers Site chilled water system Site high temperature water system

No.	Department	Description of contents
2	BUILDING MAINTENANCE	Lab equipment Fume Hoods Bio Safety Cabinets Toilet partition Toilet accessories Finishes manual Light fixtures Through-penetration firestop systems and engineering judgments
3	BUILDING SYSTEMS	Fire Alarm Security Fire Suppression sprinkler system (do not include NFPA standards)
4	EH&S (Biosafety Officer)	HEPA Filters Fume Hoods (ASHRAE 110 Test) Biological Safety Cabinets Sterilizers (auto claves) w/ seismic calculation Hood and/or BSC certification (TAB Report)
5	ELECTRIC Shop	Emergency Generators Switchgear Panel boards Transformers Motion controls Dimming panels and systems Site electrical power and lighting
6	ELEVATOR (Contract Manager)	Elevators
7	GROUNDS	Irrigation system Planting materials Site reclaimed water
8	HVAC Shop	Exhaust Fans Controls Package AC units Refrigeration (cold rooms) Fume Hoods and Bio Safety Cabinets
9	LOCK Shop	Door hardware

No.	Department	Description of contents
10	PLUMBING Shop	Water heater gas/electric DHW recirculation pump Sump pumps Plumbing fixtures Electric water cooler and drinking fountains Safety Shower/Eye wash Laboratory outlets Backflow preventors Sterilizer Glass washer Tunnel washer Fire suppression sprinkler system Fire hydrants Fire pump Domestic water booster pumps Site water, storm, sanitary, natural gas and compressed air systems.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include operation data, source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below. In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves and/or multi-rating table.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

G. Source Information: List each system, subsystem, and piece of equipment included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

H. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

I. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.

J. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

K. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

L. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

M. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by University's operating personnel for types of emergencies indicated.

C. Product Finishes Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by University's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Comply with requirements of Record Shop Drawings in Division 01 Section "Project Record Documents."

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 7823

SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Data Delivery Standards
2. Record Drawings.
3. Record Specifications.
4. Record Product Data.
5. Record Samples
6. Miscellaneous Record Submittals

B. Related Sections include the following:

1. Division 01 Section "Closeout Procedures" for general closeout procedures.
2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Divisions 02 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

A. Data Delivery Standards for UCR Planning & Design Projects – Capital Programs

1. The Capital Assets Strategies (CAS) maintains the most up-to-date base map documents. To ensure continuity and accuracy of existing site conditions, CAS manages a campus-wide Geographic Information System (GIS). All associated horizontal and vertical controls reflect current industry standards. All UCR control points are based upon the California State Plane Coordinate System, Zone 6, NAD 83, EPOCH 2009.00 with elevations based upon the North American Vertical Datum of 1988. UCR control point values will be made available to Engineers, Architects, and Land Surveyors performing Planning and Design projects on the UCR campus. To assure the utilization of campus control points and the ability to place AutoCAD drawings into GIS the following protocol is required:

    a. Upon receipt of written request from Design Builder, UCR CAS will provide an AutoCAD drawing file of the campus control points, and their values.
    b. Consultants shall use the provided Campus Control System as provided by CAS staff at the onset of a project and utilize it without alteration for all survey and mapping projects. A minimum of three Campus Control Points shall be used to constrain the survey work. In addition, one City of Riverside Control Point having an established elevation published by the City will be surveyed and the vertical difference noted on prepared drawings.

c. All drawings submitted to the UCR shall include a digital AutoCAD drawing file that will be checked for conformance with the UCR Campus Control System requirements. All project drawings not found to be in compliance with the established standards will be rejected. Revisions to the drawings shall be performed by the Consultant at no cost to the UCR.

1) Electronic Media: CD-R.

B. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal: Submit one set of bond plots from corrected Record CAD Drawings and one set of marked-up Record Prints. Design Builder will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting is acceptable. University's Representative will return plots with comments with any comments to be incorporated into Record Drawings.

b. Final Submittal: Submit one set(s) of Record CAD Drawing files, one set(s) of Record CAD Drawing Mylar plots, and one set of prints from record plots. Plot and print each Drawing, whether or not changes and additional information were recorded.

1) Electronic Media: CD-R.

C. Record Specifications: Submit one electronic file copy of Project's Specifications, including addenda and contract modifications.

1. Electronic Media: Microsoft Word, CD-R.

D. Record Product Data shall be part of operation and maintenance manuals. Insert in operation and maintenance manuals instead of a submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

b. Accurately record information in an understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order.
k. Changes made University's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.
o. Final University furnished room numbering.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record CAD Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with University's Representative. Prepare a full set of corrected CAD Drawings of the Contract Drawings, as follows:

1. Format: Same CAD program, version, and operating system as the original Contract Drawings.
2. Format: AutoCAD DWG, Version 2010 or later, operating in Microsoft Windows operating system.
3. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.

C. Record Shop Drawings: Prepare Shop Drawings instead of revising the Design Professional drawings as Record Drawings when Shop Drawings have been produced for the project. This shall include Coordination and Detailing Activity (CDA) drawings.

1. Revise Design Professional drawings to refer to Shop Drawing sheet for Record Drawing information for that particular product, material or equipment shown on the Shop Drawing.
2. Shop Drawings as Record Drawings shall detail and show requirements to record the actual physical installation and its relation to other construction. Integrate Shop Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and Record Shop Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in shipping containers. Mark each container with identification. If container does not include a complete set, identify Drawings included.
3. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file.
4. Identification: As follows:

    a. University's Project name and number.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Design Professionals.
    e. Name of Design Builder.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Note related Change Orders and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 RECORD SAMPLES

A. Immediately before date of Substantial Completion, meet with University's Representative at Project site to determine which Samples maintained during the construction period shall be transmitted to University for record purposes.

B. Comply with University Representative's instructions for packaging, identification marking, and delivery to University's Sample storage space. Dispose of other Samples in the manner specified for disposing surplus and waste materials

2.5 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Miscellaneous records include, but are not limited to, the following:

1. Field records on excavations and foundations.
2. Field records on underground construction and similar work.
3. Surveys showing locations and elevations of underground lines.
4. Invert elevations of drainage piping.
5. Surveys establishing building lines and levels.
6. Authorized measurements using unit prices or allowances.
7. Records of plant treatment.
8. Ambient and substrate condition tests.
9. Certifications received in lieu of labels on bulk products.
10. Batch mixing and bulk delivery records.
11. Testing and qualification of trades persons.
12. Documented qualification of installation firms.
13. Load and performance testing.
14. Inspections and certifications by governing authorities.
15. Leakage and water-penetration tests.
16. Fire-resistance and flame-spread test results.
17. Final inspection and correction procedures.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur. University's Representative and IOR shall review documents during the monthly Application for Payment.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction.

Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for University's Representative's reference during normal working hours.

END OF SECTION 01 7839

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for instructing University's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training videotapes.
4. Operator Training Schedule

B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
2. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.2 SUBMITTALS

A. Instruction Program: Submit four copies of Basic System Training Schedule form with the outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. At completion of training, submit two complete training manual(s) for University's use.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.3 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.

2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.4 COORDINATION

A. Coordinate instruction schedule with University's operations. Adjust schedule as required to minimize disrupting University's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by University's Representative.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. Systems and equipment listed below are minimum examples that might apply to the project. Revise to suit Project:

1. Motorized doors, such as overhead coiling doors, overhead coiling grilles and automatic entrance doors.
2. Equipment, such as stage equipment, projection screens, loading dock equipment, waste compactors, food-service equipment and laboratory fume hoods.
3. Fire-protection systems, such as fire alarm, fire pumps and fire-extinguishing systems.
4. Conveying systems, such as elevators.
5. Medical equipment, such as medical gas equipment and piping.
6. Laboratory equipment, such as laboratory air and vacuum equipment and piping.
7. Heat generation, such as boilers, feedwater equipment, pumps, steam distribution piping and water distribution piping.
8. Refrigeration systems, such as chillers, cooling towers, condensers, pumps and distribution piping.
9. HVAC systems, such as air-handling equipment, air distribution systems, and terminal equipment and devices.
10. HVAC instrumentation and controls.
11. Electrical service and distribution, such as transformers, switchboards, panel boards and motor controls.
12. Packaged engine generators, such as transfer switches.
13. Lighting equipment and controls.

14. Communication systems, such as intercommunication, surveillance, clocks and programming, voice and data, and television equipment.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project Record Documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.

i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct University's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed on times.

1. Schedule training with University's Representative with at least 14 days' advance notice.

2. Fill out and expand, if necessary, the schedule form attached at the end of this section to reflect equipment and systems on the project.

C. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 7900

UCR PHYSICAL PLANT

Project Number: 950528

OPERATOR TRAINING SCHEDULE - - MULTIDISCIPLINARY RESEARCH BUILDING 1

Session	Division	System	Training Specification	Hours Specified	UCR hours needed	UCR requested agenda	*Date completed*	*UCR Sign-off*
B	15071	Vibration & Seismic Controls for Plumbing/HVAC piping	"Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems."	N/A	15 minutes	Pertains to all HVAC rotating equipment listed in Schedule 15071/3.8. Review procedure for inspection, adjustment, and replacement of all styles provided.		
B	15185	Hydronic Pumps	"Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps."	N/A	30 minutes	Review all pump styles provided, note motor lubrication requirements, present spare mech'l seals for each pump as required by 15185/1.8, and show O&M manual pages which specifically list all installed pump models as per 01730/1.4/H.		
B	15186	Steam Condensate Pumps	"Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain steam condensate pumps."	N/A	30 minutes	Demonstrate alternating & high level control operations, review service procedure for isolating single pump for repairs. Show O&M manual pages which specifically list all installed pump models as per 01730/1.4/H.		
	15202	Ultra Pure Water System	"Provide advanced training (classroom and on-the-job) in the operation and maintenance of the UPW system for Owner's staff for a minimum of 8 hours in the classroom and 8 hours on the job at substantial completion."	16 hours		(PLUMBING SHOP)		
	15203	Deionized Water Piping	"Provide advanced training (classroom and on-the-job) in the operation and maintenance of the DI water system for Owner's staff for a minimum of 8 hours in the classroom and 8 hours on the job at substantial completion."	16 hours		(PLUMBING SHOP)		
G	15205	Process Cooling Water System	"Provide minimum of four hours training and orientation for six of Owner's operators."	4 hours	1 hour *(30 minutes each for factory rep and controls rep)*	Note motor lubrication requirements, present spare mech'l seals for each pump as required by 15185/1.8, and show O&M manual pages which specifically list all installed pump models as per 01730/1.4/H. Show sensor initial calibration records. Review mechanical installation and sequence of operation. Review service procedure for isolating single pump for repairs. Demonstrate control interface (EMS front end).		
	15211	Clean Dry Air and Utility Nitrogen Piping Copper	"Provide minimum of four hours training and orientation for six of Owner's operators."	4 hours		(PLUMBING SHOP)		
	15214	Bulk Gas System	(Classroom & on-site training, and followup visits and supervision as per 15214/1.5/F)	8 hours classroom 64 hours followup		(PLUMBING SHOP)		
	15215	Stainless Steel Piping (Electropolished)	"Provide minimum of four hours training and orientation for six of Owner's operators."	4 hours		(PLUMBING SHOP)		
B	15220	Process Vacuum System	"Provide minimum of four hours training and orientation for six of Owner's operators." "Coordinate demonstration of pump failure modes with controls contractor."	4 hours	1 hour *(30 minutes each for factory rep and controls rep)*	Note motor lubrication and other periodic maintenance requirements, and show O&M manual pages which specifically list all installed pump models as per 01730/1.4/H. Review mechanical installation and sequence of operation. Review service procedure for isolating single pump for repairs. Demonstrate control interface and pump failure modes(EMS front end).		
	15232	Industrial Wastewater Piping	"Provide advanced training (classroom and on-the-job) in the maintenance of the acid wastwater drain and collection system for Owner's staff."	N/A		(PLUMBING SHOP)		
	15233	Industrial Wastewater Treatment System	"To be held at the Owner's site and shall address basic operations, controls, controller programming, software, maintenance and troubleshooting. Training times shall be scheduled with the Owner 2 weeks in advance of training."	N/A		(PLUMBING SHOP)		

UCR PHYSICAL PLANT

Project Number: 950528

OPERATOR TRAINING SCHEDULE - - MULTIDISCIPLINARY RESEARCH BUILDING 1

Session	Division	System	Training Specification	Hours Specified	UCR hours needed	UCR requested agenda	*Date completed*	*UCR Sign-off*
B	15270	Clean Dry Air System	"Provide minimum of four hours training and orientation for six of Owner's operators." "Coordinate demonstration of system failure modes with controls contractor."	4 hours	30 minutes	COMPRESSOR TRAINING Demonstrate operation of dessicant driers. Describe maintenance procedures and review normal/abnormal system indications, pressures etc. *(Controls contractor to demonstrate failure mode and alarms)*		
G	15715	Cleanroom and Lab Make-up Airhandling Units	"Provide services of a Manufacturer's representative to train using Agency's personnel in operating and maintenance procedures. Training shall be scheduled at Using Agency's convenience and shall consist of two four-hour long sessions at Using Agency's facility."	8 hours	2 hours *(1 hour each for factory rep and controls rep)*	Note bearing & motor lubrication and other periodic maintenance requirements, show unit safety device locations, present spare parts (filters, bearings, and damper motor) for each unit as required by 15715/1.9, describe procedures for maintenance replacement of coils, bearings, fans etc. Show O&M documentation of installed fan curves and performance data, review design limits for increasing air volume with existing fan & drive assembly. Review sequence of operation and demonstrate control interface (EMS front end).		
G	15717	Filter Fan Units	"Provide services of a Manufacturer's representative to train using Agency's personnel in operating and maintenance procedures. Training shall be scheduled at Using Agency's convenience and shall consist of two four-hour long sessions at Using Agency's facility."	8 hours	1 hour *(30 minutes each for factory rep and controls rep)*	Note bearing & motor lubrication and other periodic maintenance requirements,demonstrate use of lifting jack provided as per 15717/2.7/B, describe procedures for maintenance replacement of bearings, fans etc. Visit all installed locations. Review sequence of operation and demonstrate control interface (EMS front end). Review "dirty filter" alarm setpoints as defined in 15718/2.2/F. Review calibration procedure for filter pressure sensors.	1/20/2011 2 hours	Tech demonstrated front end interface. No motor maintenance needed. No jack or spare parts provided. No filter alarms or pressure sensors in system. Alerton attended, but interface not completed. UNIT CHANGEOUT WILL REQUIRE A LIFT.
A	15720	Air Handling Units	"Provide instructional time with the Owner's personnel to review...manuals...and routine maintenance." "1 man-day for startup and maintenance instructional time including any auxiliary equipment to make field adjustments."	*not to exceed* 8 hours	2 hours *(1 hour each for factory rep and controls rep)*	Note bearing & motor lubrication and other periodic maintenance requirements, describe procedures for maintenance replacement of bearings, fans etc., show locations of unit safety devices. Review coil performance data. Visit all installed locations. Review sequence of operation and demonstrate control interface (EMS front end).		
A	15763	Fan Coil Units	"Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units."	N/A	1 hour *(30 minutes each for factory rep and controls rep)*	Note bearing & motor lubrication and other periodic maintenance requirements, describe procedures for maintenance replacement of bearings, fans etc. Visit all installed locations. Review sequence of operation and demonstrate control interface (EMS front end).		
A	15837	Centrifugal Fans	"Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans."	N/A	30 minutes	Show O&M documentation of installed fan curves and performance data, review design limits for increasing air volume with existing fan & drive assembly. Provide factory design data for maximum rated rpm of all installed fans.		

UCR PHYSICAL PLANT

Project Number: 950528

OPERATOR TRAINING SCHEDULE - - MULTIDISCIPLINARY RESEARCH BUILDING 1

Session	Division	System	Training Specification	Hours Specified	UCR hours needed	UCR requested agenda	*Date completed*	*UCR Sign-off*
C	15840	Air Terminal Units	"Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units."	N/A	2 hours *(30 minutes for factory rep and 1.5 hours for controls rep)*	Visit locations for each installed type (VAV, CAV, with & without reheat, etc.) and review installed components and accessories (control valve package, airflow sensor, etc.). Review performance and other data posted on manufacturer's labels. Describe method of disassembly for repair if any. Review all air distribution plans. Review all sequence of operation modes and demonstrate control interface (EMS front end). Demonstrate thermostat operation locally and via front end.		
C, D	15841	Laboratory Airflow Control System	"The contractor shall provide competent instructors to give complete and specific on site instruction...in lieu of a general training course." "Training shall consist of not less than 16 hours for Construction Manager-designated operating personnel." "...additional training shall be available from the Contractor at a future agreeable date that is to be stated in the Contract."	*no less than* 16 hours	2 hours basic orientation Advanced training negotiable	Visit all typical hardware installations, review air distribution and sequence of operation including fume hood controls. Review all as-built documentation. Describe hardware maintenance and repair procedures. Demonstrate control interface (EMS front end). Demonstate return from loss of power to front end interfaces. Describe scope/schedule of contractor-provided 2 year preventive maintenance program as required by 15841/3.4/A. Review system startup report provided under 15841/3.2/B. Demonstrate all system data at operator interface as required by 15841/3.5/A. Demonstrate procedures for LACS data backup and restore. Instruction in advanced troubleshooting of LACS and its data connection to standard EMS.		
E,F	15900	HVAC Instrumentation and Controls	"Provide 8 hours of inspection training during construction showing UCR Physical Plant Personnel the location of control equipment and wiring routing. Schedule with UCR." "Provide 40 hours of on site training."	48 hours	*(Inspection training did not occur)* 4 hours basic orientation Advanced training negotiable	Review all as-built documentation. Visit locations of all supervisory network devices, and review typical installations of field controllers with attention to access and serviceability. Review sequences of operation with reference to 15900/Appendix and with mechanical plans, and discuss revisions since design. Review all equipment schedules and demonstrate editing. Review all graphic screen elements with reference to sequence of operation. Demonstrate procedures for operator override, trend creation and review, alarm acknowledgment and history. Review items coordinated with UCR Physical Plant as required by 15900/1.9/K,L,M.		

SESSION SCHEDULED LENGTH: SESSION SCHEDULED DATE & TIME:

A	3.5	hours
B	2.75	hours
C	2	hours
D	*TBD*	
E	2	hours
F	*TBD*	
G	4	hours

PART 1 - SECTION **01 8050 - CALGREEN ENVIRONMENTAL REQUIREMENTS GENERAL**

1.1 SUMMARY

A. Section includes: Comply with *CAL*Green environmental requirements related to energy efficiency, water efficiency and conservation, material conservation and resource efficiency, and environmental quality.

1. Nonresidential Projects: Comply with specific *CAL*Green requirements for nonresidential projects.

1.2 ENVIRONMENTAL REQUIREMENTS

A. Mandatory Measures: Comply with *CAL*Green Mandatory Measures applicable to Project.

1. Design team and construction team are each required to participate to maximum degree possible to achieve CALGreen environmental requirements.
2. Bridging Documents are not intended to limit alternative means of achieving environmental requirements.
    a. Suggestions from Design/Build Contractor, subcontractors, suppliers, and manufacturers for achieving environmental requirements are encouraged; team approach is also encouraged.
3. Voluntary Tiers: Construction team is encouraged to achieve enhanced Voluntary Tier levels by incorporating additional measures as defined in CALGreen Appendixes.
    a. Design/Build team is required to achieve Mandatory Measures and to achieve as much as possible without unacceptable cost impact or schedule impact on Project.

B. Requirements: Design/Build team is required to review CALGreen requirements relative to Nonresidential Projects.

1. Energy Efficiency: Comply with California Energy Commission requirements.
2. Water Efficiency and Conservation: Comply with requirements for both indoor and outdoor water use.

C. Material Conservation and Resource Efficiency:

1. Nonresidential Projects: Provide weather-resistant exterior wall and foundation envelope including prevention of landscape irrigation spray on structures (if any), and prevent water intrusion at exterior entries.
2. Construction Waste: Provide construction waste management plan as defined by *CAL*Green with at least 95% of construction waste diverted from landfill by recycling or salvage for reuse.
3. Nonresidential Project Building Maintenance and Operation: Provide for commissioning requirements as required by *CAL*Green including but not limited to testing, documentation and training, testing and adjusting.

D. Nonresidential Projects Environmental Quality:

1. Mechanical Equipment Pollution Control: Cover duct and related air distribution component openings to prevent dust and debris accumulation.
2. Finish Material Pollution Control: Comply with *CAL*Green requirements for volatile organic compound (VOC) emissions including but not necessarily limited to following (as applicable):
    a. Adhesives, sealants and caulks.
    b. Paints and coatings.
    c. Carpet systems including carpet, carpet cushion, and adhesives.
    d. Resilient flooring systems.
    e. Composite wood products formaldehyde limitations.
3. Filters: Comply with requirements for mechanically ventilated buildings to have air filtration media for outside and return air prior to occupancy.
4. Environmental Tobacco Smoke (ETS) Control: Comply with *CAL*Green requirements for ETS.
5. Interior Moisture Control: Comply with California Building Code requirements and *CAL*Green requirements for vapor retarder at concrete slab foundations and capillary break (aggregate base).
6. Building Material Moisture Content: Do not use water damage building materials, remove and place wet and high moisture content insulation, and do not enclose wall or floor framing when moisture content exceeds 19%.
7. Indoor Air Quality: Comply with *CAL*Green requirements for outside air delivery and carbon dioxide monitoring.
8. Environmental Comfort: Comply with *CAL*Green requirements for whole acoustical control and interior sound control.
9. Outdoor Air Quality: Comply with *CAL*Green requirements for reduction of greenhouse gases and ozone depletion.

E. Planning and Design: Construction team shall coordinate with Design Team regarding Project Planning and Design methods related to *CAL*Green requirements related to Project design and shall comply with requirements related to construction.

1.3 QUALITY ASSURANCE

A. Project Management and Coordination: Contractor to identify one person on Contractor's staff to be responsible for *CAL*Green issues compliance and coordination.

1. Experience: Environmental project manager to have experience relating to CALGreen building construction.
2. Responsibilities: Carefully review Contract Documents for CALGreen issues, coordinate work of trades, subcontractors, and suppliers; instruct workers relating to environmental issues; and oversee Project Environmental Goals.
3. Meetings: Discuss CALGreen Goals at the following meetings.
    a. Pre-construction meeting.

b. Pre-installation meetings.

c. Regularly scheduled job-site meetings.

d. *CAL*Green Issues Criteria: Comply with requirements listed in *CAL*Green and various Specification sections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General Issues: Do not use materials with moisture stains or with signs of mold or mildew.

1. Moisture Stains: Materials that have evidence of moisture damage, including stains, are not acceptable, including both stored and installed materials; immediately remove from site.

2. Mold and Mildew: Materials that have evidence of growth of molds or of mildew are not acceptable, including both stored and installed materials; immediately remove from site.

PART 3 - EXECUTION

3.1 PROTECTION

A. Environmental Issues: Protect interior materials from water damage; where interior products not intended for wet applications are exposed to moisture, immediately remove from site.

1. Protect installed products using methods that do not support growth of molds and mildews. Immediately remove from site materials with mold and materials with mildew.

END OF SECTION

SECTION 01 8113 – SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements, procedures, and application of sustainable principles including USGBC LEED 2009 Building Design and Construction (BD+C) rating system for project certification from GBCI, Cal-Green Code.

1. Project shall achieve LEED Silver rating as awarded by GBCI as part of Base Bid.
2. Alternate Rating: Refer to Division 01 Section Alternates.
3. Comply with California Green Building Standards.

a. Submit CALGreen Cal-Green Checklists (refer to Attachment #1) within 30 days of NPT with description of proposed method of compliance, based upon code analysis and code study.
b. Note: Design Builder must review Project Specifications, Campus Standards & Project Planning Guidelines, LEED Requirements, Basis of Design and all other RFP and code requirements, and meet or exceed the most stringent requirements, including the Cal-Green requirements.

B. The Design Builder's responsibilities shall include, but not be limited to the following:

1. Design Builder must design, construct, document, and execute project for compliance with USGBC LEED 2009 Building Design and Construction (BD+C) rating system prerequisites and credits as necessary for LEED Silver certification.
2. Comply with all prerequisite and credit requirements necessary to achieve LEED Silver certification from GBCI. Provide reports, calculations, drawings, exhibits and other documentation required.
3. Design Builder must comply with USGBC and GBCI policies and rules.
4. Design Builder must manage, coordinate, plan, and meet with University Representative, design professionals and specialty contractors to develop action plans and select credits as necessary to implement and achieve GBCI approval, in order to meet project goals.
5. Achieve specific mandatory credits required by the University – Refer Part 3.
6. Selection of LEED credits necessary to obtain certification of LEED rating and GBCI award are the Design Builder's choice. The Design Builder shall select credits and edit Drawings, and Divisions 02 through 33 to incorporate the LEED requirements as applicable. Incorporate all requirements into design and construction.
7. University will register the project on LEED Online.
   a. University will provide Design Builder access to LEED Online for administration purposes
   b. Manage LEED On-line electronic documenting system per the requirements of GBCI. Coordinate work with design professionals, and specialty contractors.
   c. Provide all documentation required for LEED Online.

      1) The University will participate in review of the project.

2) The University may add or pursue additional credits, and may provide documentation for GBCI review and approval.
3) Design Builder responsible for responding to all review clarifications for prerequisites and credits submitted by them for LEED certification until all prerequisites are awarded and credit(s) are rewarded or denied.

8. Design Builder shall provide all work and services associated with implementation, procedures, material, design, engineering, labor documentation, related to acquiring LEED certification. Any costs associated with appeals of prerequisite and/or credits submitted by Design Builder, deemed necessary by UCR, will be sole responsibility of Design Builder.

C. University Required Credits

1. Design Builder shall achieve GBCI approval of University required LEED credits as indicated on the LEED Project Checklist in Part 3.

D. University Sustainability

1. All new building projects, other than acute care facilities, shall be designed, constructed, and commissioned to outperform the CBC energy-efficiency standards 2013 by at least 20% by energy cost and/or meet Whole Building Energy Targets set by UCOP. A copy is included in the project RFP exhibits.
2. All new building projects will achieve at least two points within the available credits in LEED-New Construction's Water Efficiency category.
3. Waste reduction and recycling shall be prioritized. Design Builder must achieve 95% diversion.

E. Southern California Gas (SoCal Gas) Savings by Design Program (SBD)

1. Project participation in this energy savings and rebate program for the SoCal Gas portion is a mandatory requirement. Design Builder must engage SoCal Gas Representative within 3 weeks of Notice to Proceed.
2. Title-24 performance for a stand-alone building modeled without the UCR central plant must be 20% by energy cost, better than code minimum performance.
3. Savings by Design: an energy efficiency program offered by California's four investor-owned utility companies and the Sacramento Municipal Utility District. Savings by Design provides design assistance, energy analysis, life-cycle costing, and financial incentives for new construction and major renovation projects. The Savings by Design program is also known as the Non-Residential New Construction Program which is applicable to high-rise residential as defined in the Energy Efficiency Standards.
4. All equipment provided as part of this project shall meet the SBD energy performance requirements, which exceed code minimum requirements.

F. Related Sections:

1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.2 DEFINITIONS

A. CBC: California Building Code, Title 24 portion of the California Code of Regulations

B. GBCI: Green Building Certification Institute. Refer to GBCI website (http://www.gbci.org).

C. LEED: Leadership in Energy and Environmental Design. LEED is a registered trademark of the U.S. Green Building Council (USGBC). This trademark applies to all occurrences of LEED in this document. LEED is a green building rating system developed and administered by the non-profit U.S. Green Building Council. The four levels of LEED certification, from lowest to highest, are Certified, Silver, Gold, and Platinum.

D. LEED 2009 NC: LEED 2009 for New Construction and Major Renovations rating system. Refer to The LEED Reference Guide for Green Building Design and Construction, 2009 Edition, available for purchase from USGBC website store. Include all addendums and updates to the latest edition, as applicable.

E. USGBC: US Green Building Council. Refer to USGBC website (http://www.usgbc.org). U.S. Green Building Council. The USGBC is a membership-based non-profit organization dedicated to sustainable building design and construction, and is the developer of the LEED building rating system.

1.3 SUBMITTALS

A. General: Submit additional LEED submittals required by other Specification Sections.

B. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to proceed indicating how GBCI certification of project LEED rating will be achieved. Include description of how each project Credit and Prerequisite will be met, including the following:

1. Credit EQc3.1: Construction indoor-air-quality management plan.
2. Credit MRc2: Waste management plan complying with Division 01 Section "Construction Waste Management."
3. Credit MRc3: (Selections are optional) List of proposed salvaged and refurbished materials. Identify each material that will be salvaged or refurbished, including its source and cost.
4. Credit MRc4: (Selection is optional) List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
5. Credit MRc5: (Selection is optional): List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
6. Credit MRc7: (Selection is optional): List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.

C. LEED Online Project Registration: Design Builder to coordinate with University Representative to confirm receipt of LEED Online project registration from the GBCI no later than 30 days after the date of Notice To Proceed.

D. Final LEED Submission: All prerequisite and credit document materials to complete the final LEED application to LEED On-line shall be completed and uploaded no later than 15 days after the completion of the building's final commissioning. Submit verification of submittal to University Representative for review.

E. LEED Certification Award: All prerequisites and credits, if questioned by GBCI, must be coordinated and clarified until awarded and LEED certification is achieved. Submit clarification documentation to University Representative for review and record. University Representative will distribute copies of LEED certification award, upon request.

F. CalGreen Checklists: (For Checklists see Attachments #1 at the end of this Section) Submit completed Checklists with the following information:

1. Describe method of compliance with the California Green Building Standards Code on the Checklists,
2. Indicate location where code compliance is shown within the final construction design package; Sheet No.'s, Detail No.'s, Specification Section/Paragraph No.'s. Indicate location of design information which displays code compliance on the Checklists.
3. Submit Completed Checklists with design packages for review/approval.

G. Southern California Gas (SoCal Gas) Savings by Design Program (SBD) registration: Provide SBD Design Team application no later than 30 days after the date of Notice to Proceed.

1.4 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements with University Representative. Design Builder's LEED coordinator may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 Provide materials as determined during project design as necessary to accomplish approval of LEED prerequisites and credits.

PART 3 - EXECUTION

3.1 SUSTAINABLE SITES

A. Prerequisite SSp1: Verify compliance of site selection credit early in the design phase.

B. Credit SSc1: Provide documentation of site selection to achieve this credit.

C. Credit SSc4.2: Provide documentation of bike racks and showers to achieve this credit.

D. Credit SSc4.4: Provide documentation of no new parking to achieve this credit.

E. Credit SSc5.1: Provide documentation of Site Development – Protection or restoration of habitat to achieve this credit.

F. Credit SSc5.2: Provide documentation of Site Development – Maximization of open spaces that promote biodiversity and recreation to earn this credit.

G. Credit SSc6.1: Project requirement is to ensure that post construction storm runoff does not exceed the preconstruction storm runoff – see Scope of Work and UCR Long Range Development Plan.

1. The Project drainage study shall establish that pre-project hydrologic conditions affecting downstream conditions would be maintained by the proposed project by incorporating site design, source control or treatment control BMPs or by demonstrating that there would be no significant impact to the downstream receiving waters.
2. All land disturbance of 1 acre or greater, shall meet the following (Reference: November 2005 UCR Long Range Development Plan Final EIR):

    a. Site design that controls runoff discharge volumes and durations shall be utilized, where applicable and feasible, to maintain or reduce the peak runoff for the 10-year, 6-hour storm event in the post-development condition compared to the pre-development condition, or as defined by current water quality regulatory requirements.
    b. Measures that control runoff discharge volumes and durations shall be utilized, where applicable and feasible, on manufactured slopes and newly-graded drainage channels, such as energy dissipaters, revegetation (e.g., hydroseeding and/or plantings), and slope/channel stabilizers.

H. Credit SSc6.2: Provide documentation of Stormwater Design – Quality Control to achieve this credit.

I. Credit SSc7.1: Provide documentation of Heat Island Effect – Non-roof to achieve this credit.

J. Credit SSc7.2: Design roofing for compliance to achieve this credit.

3.2 WATER EFFICIENCY

A. **University of California, Riverside mandates that all new construction project will achieve at least two points within the available credits in Water Efficiency.**

B. Credit WEc1: Use no potable water for irrigation, and reduce irrigation to earn 4 points.

C. Credit WEc3: Reduce Water Use by 35%. Reduce by 40% to earn Regional Credit.

3.3 ENERGY AND ATMOSPHERE

A. University of California, Riverside mandates that all new construction projects achieve 20% (by energy cost) or better than Title 24 -2013 code requirements.

B. Credit EAc1: Design a building that achieves 20% (by energy cost) or better than Title 24 – 2013 code requirements.

1. Title-24 energy modeling and calculation – Central plant modeling within the building model is required for LEED projects. The University has documentation on central plant chillers, cooling towers, pumps, thermal energy tank, operating sequences, and other information available for energy modeling performed by the Design Builder.

a. Note: energy models for SoCal Gas 'Savings by Design' must be performed without the input of the central plant equipment, as code requires building Title-24 calculations as a stand-alone building.

C. Credit EAc2: This credit for on-site solar power will be eligible for attempting only after the Design Builder has attempted 73 points or higher without it. At that point, the University will provide data and documentation to earn the points associated with this additional credit.

D. Credit EAc3: Provide enhanced commissioning to earn this credit.

E. Credit EAc4: If refrigerants are provided on the project, comply with the requirements of this credit. Provide design and documentation to earn this credit in any case.

1. The University has existing documentation on the existing central plant chiller refrigerants available for use by the Design Builder to perform LEED Template documentation of this credit.

F. Credit EAc5 (Selection is optional): Implement measurement and verification plan consistent with Option B: Energy Conservation Measure Isolation in the EVO's "International Performance Measurement and Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction."

1. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements. Additional sub-metering of lighting may be required to achieve this credit.
2. Evaluate energy performance and efficiency by comparing actual to predicted performance. Provide calibrated model.
3. Measurement and verification period shall cover at least one year of post-construction occupancy.

G. Credit EAc6: This credit for green power will be eligible for attempting only after the Design Builder has attempted 73 points or higher without it. At that point, the University will provide data and documentation to earn the points associated with this additional credit.

3.4 MATERIAL RESOURCES

A. University of California, Riverside mandates that all new construction projects achieve 95% construction waste diversion.

B. Credit MRc2: Comply with requirements to attain at least 95% recycled or salvaged construction materials.

1. Comply with Division 01 Section 017419 "Construction Waste Management."

C. Credit MRc4: Comply with the requirements for recycled content to achieve this credit.
Credit MRc5: Comply with the requirements for regional materials to achieve this credit.

3.5 INDOOR ENVIRONMENTAL QUALITY

A. Credit EQc1: Comply with outdoor air monitoring requirements necessary to achieve this credit.

B. Credit EQc3.1: Comply with requirements necessary to achieve this credit.

1. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
2. If University's Representative authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install temporary filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
3. Replace all temporary air filters with new filters immediately prior to occupancy.

C. Credit EQc3.2: Comply with requirements of this credit to ensure air quality prior to occupancy.

D. Credit EQc4.1: Provide low emitting adhesives and sealants as required to achieve this credit.

E. Credit EQc4.2: Provide low emitting paints and coatings as required to achieve this credit.

F. Credit EQc4.3: Provide low emitting flooring systems as required to achieve this credit.

G. Credit EQc4.4: Provide low emitting composite wood and agrifiber products as required to achieve this credit. This credit applies to the manufacturing of **all** composite materials and laminating adhesives used on the project.

H. Credit EQc5: Provide necessary design and construction to achieve indoor chemical and pollutant source control as required to achieve this credit.

I. Credit EQc6.1: Provide necessary system design of high-performance lighting systems through increased controllability for building occupants as required to achieve this credit.

J. Credit EQc6.2: Provide necessary system design of multi-occupant spaces through increased controllability of thermal comfort for building occupants as required to achieve this credit.

3.6 INNOVATION AND DESIGN

A. Credit IDc1.1 Provide innovation exemplary performance to achieve this credit.

B. Credit IDc1.2 Provide innovation exemplary performance to achieve this credit.

C. Credit IDc1.3: Provide innovation exemplary performance to achieve this credit.

D. Credit IDc1.4: Provide innovation strategy to achieve this credit.

E. Credit IDc1.5: Provide innovation strategy to achieve this credit.

F. Credit IDc2: UCR will document credit with UCR LEED AP.

3.7 Regional Priority Credits

A. Credit RPc1.1: Attempt regional priority credits based on project zip code 92521

B. Credit RPc1.2: Attempt regional priority credits based on project zip code 92521

C. Credit RPc1.3: Attempt regional priority credits based on project zip code 92521

D. Credit RPc1.4: Attempt regional priority credits based on project zip code 92521

3.8 PROJECT CREDIT CHECKLIST

A. Design Builder must achieve Prerequisites, as required by GBCI.

B. Legend – The table below identifies the abbreviations used on the Project Checklist and establishes minimum project requirements.

Abbreviation	Descriptor	Description:
P	"Prefer"	Indicates credits that the University would prefer Design Builder obtain for meeting accreditation goal as determined by the project RFP.
DB	"Design Builder"	Indicates credits that the Design Builder should consider achieving for meeting accreditation goal as determined by the project RFP.

C. Checklist starts on the next page:

LEED 2009 for New Construction and Major Renovations

Project Checklist

UCR Campus LEED NC Checklist

November 2015

Sustainable Sites — Possible Points: 26

Y	?	N			
Y			Prereq 1	Construction Activity Pollution Prevention	
DB			Credit 1	Site Selection	1
		P	Credit 2	Development Density and Community Connectivity	5
			Credit 3	Brownfield Redevelopment	1
		P	Credit 4.1	Alternative Transportation—Public Transportation Access	6
DB			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
DB			Credit 4.4	Alternative Transportation—Parking Capacity	2
DB			Credit 5.1	Site Development—Protect or Restore Habitat	1
DB			Credit 5.2	Site Development—Maximize Open Space	1
DB			Credit 6.1	Stormwater Design—Quantity Control	1
DB			Credit 6.2	Stormwater Design—Quality Control	1
DB			Credit 7.1	Heat Island Effect—Non-roof	1
DB			Credit 7.2	Heat Island Effect—Roof	1
		P	Credit 8	Light Pollution Reduction	1

Water Efficiency — Possible Points: 10

Y	?	N			
Y			Prereq 1	Water Use Reduction—20% Reduction	
DB			Credit 1	Water Efficient Landscaping	2 to 4
	DB		Credit 2	Innovative Wastewater Technologies	2
DB			Credit 3	Water Use Reduction	2 to 4

Energy and Atmosphere — Possible Points: 35

Y	?	N			
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
DB			Credit 1	Optimize Energy Performance	1 to 19
DB			Credit 2	On-Site Renewable Energy	1 to 7
DB			Credit 3	Enhanced Commissioning	2
		P	Credit 4	Enhanced Refrigerant Management	2
		P	Credit 5	Measurement and Verification	3
		P	Credit 6	Green Power	2

Materials and Resources — Possible Points: 14

Y	?	N			
Y			Prereq 1	Storage and Collection of Recyclables	
			Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
			Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
DB			Credit 2	Construction Waste Management	1 to 2
			Credit 3	Materials Reuse	1 to 2

Materials and Resources, Continued

Y	?	N			
DB			Credit 4	Recycled Content	1 to 2
DB			Credit 5	Regional Materials	1 to 2
			Credit 6	Rapidly Renewable Materials	1
DB			Credit 7	Certified Wood	1

Indoor Environmental Quality — Possible Points: 15

Y	?	N			
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
		P	Credit 1	Outdoor Air Delivery Monitoring	1
		P	Credit 2	Increased Ventilation	1
DB			Credit 3.1	Construction IAQ Management Plan—During Construction	1
DB			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
DB			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
DB			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
DB			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
DB			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
DB			Credit 5	Indoor Chemical and Pollutant Source Control	1
DB			Credit 6.1	Controllability of Systems—Lighting	1
DB			Credit 6.2	Controllability of Systems—Thermal Comfort	1
			Credit 7.1	Thermal Comfort—Design	1
			Credit 7.2	Thermal Comfort—Verification	1
		P	Credit 8.1	Daylight and Views—Daylight	1
		P	Credit 8.2	Daylight and Views—Views	1

Innovation and Design Process — Possible Points: 6

Y	?	N			
DB			Credit 1.1	Innovation in Design: EP MRc2 95% reduction	1
DB			Credit 1.2	Innovation in Design: EP WEc3 with 45% reduction	1
P			Credit 1.3	Innovation in Design: EP Certified Wood 100%	1
P			Credit 1.4	Innovation in Design:	1
P			Credit 1.5	Innovation in Design:	1
DB			Credit 2	LEED Accredited Professional	1

Regional Priority Credits — Possible Points: 4

Y	?	N			
DB			Credit 1.1	Regional Priority: EAc2	1
DB			Credit 1.2	Regional Priority: SSc7.1	1
P			Credit 1.3	Regional Priority: WEc3 at 40%	1
P			Credit 1.4	Regional Priority: IEQc8.1	1

Total — Possible Points: 110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

END OF SECTION 01 8113

LIST OF ATTACHMENTS:

1. ATTACHMENT #1 - Cal-Green Non-Residential Checklist

Attachment #1 – Cal-Green Non-Residential Checklist

Feature or Measure	Design-Build Method of Compliance Dwg/Spec/Detail No.	UCR Use	
		Design Review	Field Inspection
Requirements			
Project meets all of the requirements of Divisions **5.1** through **5.5.**			
Planning & Design			
Site Development			
5.106.1 Storm water pollution prevention. Newly constructed projects which disturb less than one acre of land shall prevent the pollution of storm water runoff from the construction activities through local ordinance in Section 5.106.1.1 or Best management practices (BMP) in Section 5.106.1.2.			
5.106.4 Bicycle parking and changing rooms. Comply with Sections 5.106.4.1 and 5.106.4.2; or UC Policy.			
5.106.4.1 Short-Term bicycle Parking. If the project is anticipated to generate visitor traffic, provide permanently anchored bicycle racks within 200 feet of the visitors' entrance, readily visible to passer-by, for 5 percent of visitor motorized vehicle parking capacity, with a minimum of one two-bike capacity rack.			
5.106.4.2 Long-Term Bicycle parking. For buildings with over 10 tenant-occupants, provide secure bicycle parking for 5 percent of tenant- occupied motorized vehicle parking capacity, with a minimum of space one space.			
5.106.5.2 Designated parking. Provide designated parking for any combination of low-emitting, fuel-efficient and carpool / van pool vehicles as shown in Table 5.106.5.2.			
5.106.8 Light pollution reduction. Outdoor lighting systems shall be designed and installed to comply with the following: 1. The minimum requirements in the *California Energy Code* for Lighting Zones 1-4 as defined in Chapter 10 of the *California Administrative Code;* and 2. Backlight, Uplight and Glare (BUG) ratings as defined in IESNA TM-15-11; and I:RI 3. Allowable BUG ratings not exceeding those shown in Table 5.106.8, or Comply with a local ordinance lawfully enacted pursuant to Section 101.7, whichever is more stringent.			
5.106.10 Grading and paving. Construction plans shall indicate how site grading or a drainage system will manage all surface water flows to keep water from entering buildings. Examples of methods to manage surface water include those shown in Items 1-5. See exception for additions or alterations.			
Energy Efficiency			
Performance Requirements			
5.201.1 Scope. Building meets or exceeds the requirements of the California Building Energy Efficiency Standards.			
Water Efficiency and Conservation			
Indoor Use			
5.303.1 Meters. Separate meters shall be installed for the uses described in Sections 5.303.1.1 and 5.303.1.2.			
5.303.1.1 New buildings or additions in excess of 50,000 square feet separate submeters shall be			

installed as follows: 1. For each individual leased, rented or other tenant space within the wilding projected to consume more than 100 gal/day. 2. Where separate submeters for individual building tenants are unfeasible, for water supplied to the following subsystems: a. Makeup water for cooling towers where flow through is greater than 500 gpm (30 Lis). b. Makeup water for evaporative coolers greater than 6 gpm (0.04 Lis). c. Steam and hot-water boilers with energy input more than 500,000 Btulh (147 kW).			
5.303.1.2 Excess consumption. Any tenant within a new building or an addition that is projected to consume more than 1,000 gal/day (3800 L/day).			
5.303.3 Water conserving plumbing fixtures and fittings. Plumbing fixtures (water closets and urinals) and fittings (faucets and showerheads) shall comply with the following:			
5.303.3.1 Water closets. The effective flush volume of all water closets shall not exceed 1.28 gallons per flush. Tank-type water closets shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Tank-Type Toilets. **Note:** The effective flush volume of dual flush toilets is defined as the composite, average flush volume of two reduced flushes and one full flush.			
5.303.3.2 Urinals. The effective flush volume of urinals shall not exceed 0.5 gallons per flush.			
5.303.3.3 Showerheads.			
5.303.3.3.1 Single showerhead. Showerheads shall have a maximum flow rate of not more than 2.0 gallons per minute at 80 psi. Showerheads shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Showerheads.			
5.303.3.3.2 Multiple showerheads serving one shower. When a shower is served by more than one showerhead, the combined flow rate of all showerheads and/or other shower outlets controlled by a single valve shall not exceed 2.0 gallons per minute at 80 psi, or the shower shall be designed to allow only one shower outlet to be in operation at a time. **Note:** A hand-held shower shall be considered a showerhead.			
5.303.4 Wastewater reduction. Each building shall reduce the generation of wastewater by one of the following methods: As applicable 1. The installation of water- conserving fixtures or 2. Utilizing nonpotab1e water systems.			
A5.303.5 Dual plumbing. New buildings and facilities shall be dual plumbed for potable and recycled water systems.			
5.303.6 Standards for fixtures and fittings. Plumbing fixtures and fittings shall be installed in accordance with the *California Plumbing Code,* and shall meet the applicable standards As applicable referenced in Table 1401.1 of the *California Plumbing Code* and in Chapter 6 of this code.			
Outdoor Water Use			
5.304.1 Water budget. A water budget shall be developed for landscape irrigation use.3 Applies to additions or alterations.			

5.304.2 Outdoor potable water use. For new water service, separate meters or submeters shall be installed for indoor and outdoor potable water use for landscaped areas of at least 1,000 square feet but not more than 5,000 square feet, separate submeters shall be installed for outdoor potable water use. Applies to additions or alterations.			
A5.304.2.1 Outdoor potable water use. For new water service not subject to the provisions of Water Code Section 535, separate meters or submeters shall be installed for outdoor potable water use for landscaped areas of at least 500 square feet but not more than 1,000 square feet (the level at which Section 5.304.2 applies).			
5.304.3 Irrigation design. In new nonresidential projects with at least 1,000 square feet but not more than 2,500 square feet of landscaped area (the level at which the MLO applies), install irrigation controllers and sensors which include the following criteria and meet manufacturer's recommendations. Applies to additions or alterations.			
5.304.3.1 Irrigation controllers. Automatic irrigation system controllers installed at the time of final inspection shall comply with the following: I. Controllers shall be weather- or soil moisture-based controllers that automatically As applicable adjust irrigation in response to changes in plants' needs as weather conditions change. 2. Weather-based controllers without integral rain sensors or communication systems that account for local rainfall shall have a separate wired or wireless rain sensor which connects or communicates with the controller(s). Soil moisture-based controllers are not required to have rain sensor input.			
Material Conservation and Resource Efficiency			
Weather Resistance and Moisture Management			
5.407.1 Weather protection. Provide a weather-resistant exterior wall and foundation envelope as required by California Building Code Section 1403.2 and California Energy Code Section 150, manufacturer's installation instructions or UCR Standards, whichever is more stringent.			
5.507.2 Moisture control. Employ moisture control measures by the following methods:			
5.407.2.1 Sprinklers. Prevent irrigation spray on structures.			
5.407.2.0 Entries and openings. Design exterior entries and openings to prevent water intrusion into buildings.			
Construction Waste Reduction, Disposal and Recycling			
5.408.1 Construction waste management. Recycle and/or salvage for reuse a minimum of 50% of the non- hazardous construction waste in accordance with Section S.408.1.1, .408.1.2 or 5.408.1.3; or meet a local construction and demolition waste management ordinance, whichever is more stringent.			
5.408.1.1 Construction waste management plan. Where a local jurisdiction does not have a construction and demolition waste management ordinance that is more stringent, submit a construction waste management plan that complies with Items 1 through 4 of this section.			
5.408.1.2 Waste management company. Utilize a waste management company that can provide verifiable documentation that the percentage of construction waste material diverted from the landfill complies with this section. **Exceptions** to Sections 5.408.1.1 and 5.408.1.2: 1. Excavated soil and land-clearing debris			

2. Alternate waste reduction methods developed by working with local agencies if diversion or recycle facilities capable of compliance with this item do not exist 3. Demolition waste meeting local ordinance or calculated in consider- ation of local recycling facilities and markets			
5.408.1.4 Documentation. Provide documentation of the waste management plan that meets the requirements listed in Sections 5.408.1.1 through 5.408.1.3, and the plan is accessible to the enforcement authority.			
5.408.3 Excavated soil and land clearing debris. 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled. **Exception:** Reuse, either on-or off-site, of vegetation or soil contaminated by disease or pest infestation.			
Building Maintenance and Operation			
5.410.1 Recycling by occupants. Provide readily accessible areas that serve the entire building and are identified for the depositing, storage and collection of nonhazardous materials for recycling.			
5.410.2 Commissioning. For new buildings 10,000 square feet and over, building commissioning for all building systems covered by T24, Part 6, process systems and renewable energy systems shall be included in the design and construction processes of the building project. Commissioning requirements shall include items listed in Section 5.410.2.			
5.410.2.1 Owner's Project Requirements (OPR). Documented before the design phase of the project begins the OPR shall include items listed in Section 5.410.4.			
5.410.2.2 Basis of Design (BOD). A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project and updated periodically to cover the systems listed in Section 5.4102.2.			
5.410.2.3 Commissioning plan. A commissioning plan describing how the project will be commissioned shall be started during the design phase of the building project and shall include items listed in Section 5.410.2.3			
5.410.2.4 Functional performance testing shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the approved plans and specifications.			
5.410.2.5 Documentation and training. A systems manual and systems operations training are required.			
5.410.2.5.1 Systems manual. The systems manual shall be delivered to the building owner or representative and facilities operator and shall include the items listed in section 5.410.2.5.1.			
5.410.2.5.2 Systems operations training. The training of the appropriate maintenance staff for each equipment type and/or system shall include items listed in Section 5.410.2.5.2.			
5.410.2.6 Commissioning report. A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post construction phases of the building project shall be completed and provided to the owner or representative.			
5.410.4 Testing and adjusting. Testing and adjusting of systems shall be required for buildings less than 10,000 square feet.			

5.410.4.2 Systems. Develop a written plan of procedures for testing and adjusting systems. Systems to be included for testing and adjusting shall include, as applicable to the project, the systems listed in Section 5.410.3.2.			
5.410.4.3 Procedures. Perform testing and adjusting procedures in accordance with industry best practices and applicable national standards on each system.			
5.410.4.3.1 HVAC balancing. Before a new space-conditioning system serving a building or space is operated for normal use, the system should be balanced in accordance with the procedures defined by national standards listed in Section 5.410.4.3.1			
5.410.4.4 Reporting. After completion of testing, adjusting and balancing, provide a final report of testing signed by the individual responsible for performing these services.			
5.410.4.5 Operation and maintenance manual. Provide the building owner with detailed operating and maintenance instructions and copies of guaranties/warranties for each system prior to final inspection.			
5.410.4.5.1 Inspections and reports. Include a copy of all inspection verifications and reports required by the enforcing agency.			
Environmental Quality			
Fireplaces			
5.503.1 Install only a direct-vent sealed –combustion gas or sealed wood- burning fireplace or a sealed woodstove and refer to residential requirements in the California Energy Code, Title 24, Part 6, Subchapter 7, Section 150.			
5.503.1.1 Woodstoves. Woodstoves shall comply with US EPA Phase II emissions limits.			
Pollutant Control			
A5.504.1 Indoor air quality (IAQ) during construction. Maintain IAQ as provided in Sections AS.S04.1.1 and AS.S04.1.2.			
A5.504.1.1 Temporary ventilation. Provide temporary ventilation during construction in accordance with Section 121 of the California Energy Code, CCR, Title 24, Part 6 and Chapter 4 of CCR, Title 8 and as listed in Items 1 and 2 in Section AS.S04.1.2.			
A5.504.1.2 Additional IAQ measures. Employ additional measures as listed in Items 1 through S in Section AS.S04.1.3.			
5.504.1.3 Temporary ventilation. If the HVAC system is used during construction, use return air filters with a MERV of 8, based on ASHRAE S2.2-1999, or an average efficiency of 30% based on ASHRAE S2.1-1992. Replace all filters immediately prior to occupancy. Applies to additions or alterations.			
5.504.3 Covering of duct openings and protection of mechanical equipment during construction. At the time of rough installation and during storage on the construction site and until final startup of the heating, cooling and ventilating equipment, all duct and other related air distribution component openings shall be covered with tape, plastic, sheet-metal or other methods acceptable to the enforcing agency to reduce the amount of dust, water and debris which may enter the system.			
5.504.4 Finish material pollutant control. Finish materials shall comply with Section 5.504.4.1 through 5.504.4.4.			
5.504.4.1 Adhesives, sealants, caulks. Adhesives and sealants used on the project shall meet the requirements of the following standards. 1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional			

air pollution control or air quality management district rules where applicable or SCAQMD Rule 1168 VOC limits, as shown in Tables 5.504.4.1 and 5.504.4.2. 2. Aerosol adhesives and smaller unit sizes of adhesives and sealant or caulking compounds (in units of product, less packaging, which do not weigh more than one pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of California Code of Regulations, Title 17, commencing with Section 94507.			
5.504.4.3 Paints and coatings. Architectural paints and coatings shall comply with Table 5.504.4.3 unless more stringent local limits apply.			
5.504.4.3.1 Aerosol paints and coatings. Aerosol paints and coatings shall meet the Product-Weighted MIR Limits for ROC in Section 94522 (a) (3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances (CCR, Title 17, Section 94520 et seq).			
5.504.4.3.2 Verification. Verification of compliance with this section shall be provided at the request of the enforcing agency.			
5.504.4.4 Carpet systems. All carpet installed in the building interior shall meet the testing and product requirements of one of the standards listed in Section 5.504.4.4.			
5.504.4.4.1 Carpet cushion. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.			
5.504.4.4.2 Carpet adhesive. All carpet adhesive shall meet the requirements of Table 5.504.4.1.			
5.504.4.5 Composite wood products. Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in Table 5.504.4.			
5.504.4.5.2 Documentation. Verification of compliance with this section shall be provided as requested by the enforcing agency. Documentation shall include at least one of the following. 1. Product certifications and specifications. 2. Chain of custody certifications. 3. Product labeled and invoiced as meeting the Composite Wood Products regulation (see CCR, Title 17, Section 93120, et seq.). 4. Exterior grade products marked as meeting the PS-I or PS-2 standards of the Engineered Wood Association, the Australian ASINZS 2269 or European 636 35 standards. 5. Other methods acceptable to the enforcing agency.			
5.504.4.6 Resilient flooring systems. Comply with the VOC-emission limits defined in the 2012 CHPS criteria and listed on its High Performance Products Database; products compliant with CHPS criteria certified under the Greenguard Children & Schools program; certified under the F1oorScore program of the Resilient Floor Covering Institute; or meet California Department of Public Health 2010 Specification.			
A5.504.4.6.1 Verification of compliance. Documentation shall be provided verifying that resilient flooring materials meet the pollutant emission limits.			
5.504.5;3 Filters. In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air that provides at least a MERV of 8. MERV 8 filters shall be installed prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.			

Exceptions: I. An ASHRAE 10-percent to 15-percent efficiency filter shall be permitted for an HVAC unit meeting the 2013 California Energy Code having 60,000 Btulh or less capacity per fan coil, if the energy use of the air delivery system is 0.4 W tcfm or less at design air flow. 2.Existing mechanical equipment. S.S04.S.3.1 Labeling. Installed filters shall be clearly la-beled by the manufacturer indicating the MERV rating.			
Interior Moisture and Radon Control			
5.505.1 Indoor moisture control. Buildings shall meet or exceed the provisions of California Building Code, CCR, Title 24, Part 2, Sections 1203 and Chapter 14.1.1.			
Air Quality and Exhaust			
5.506.1 Outside air delivery. For mechanically or naturally ventilated spaces in buildings, meet the minimum requirements of Section 121 of the California Energy Code and Chapter 4 of CCR, Title 8 or the applicable local code, whichever is more stringent.			
5.506.2 Carbon dioxide (CO2) monitoring. For buildings or additions equipped with demand control ventilation, CO2 sensors and ventilation controls shall be specified and installed in accordance with the requirements of the California Energy Code, CCR. Section 120(c)(4).			
Environmental Comfort			
5.507.4 Acoustical control. Employ building assemblies and components with STC values determined in accordance with ASTM E90 and ASTM E 413 or OITC determined in accordance with ASTM E 1332, using either the prescriptive or performance method in Section 5.507.4.1 or 5.507.4.2.			
5.507.4.1 Exterior noise transmission, prescriptive method. Wall and floor-ceiling assemblies exposed to the noise source making up the building envelope shall have exterior wall and roof ceiling assemblies meeting a composite STC rating of at least 50 or a composite OITC rating of no less than 40 with exterior windows of a minimum STC of 40 or OITC of 30 in the locations described in Items I and 2. Also applies to addition envelope or altered envelope.			
5.507.4.1.1 Noise exposure where noise contours are not readily available. Buildings exposed to a noise level of 65 dB Leq-IHr during any hour of operation shall have exterior wall and roof-ceiling assemblies exposed to the noise source meeting a composite STC or rating of at least 45 (or OITC 35), with exterior windows of a minimum STC of 40 (or OITC 30). Also applies to addition or alteration exterior wall.			
5.507.4.2 Performance method. For buildings located as defined in Sections A5.S07.4.I or AS.S07.4.1.1, wall and roof-ceiling assemblies making up the building envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level (Leq-IHr) of 50 dBA in occupied areas during any hour of operation. Also applies to addition envelope or altered envelope.			
5.507.4.2.1 Site features. Exterior features such as sound walls or earth berms may be utilized as appropriate to the project to mitigate sound migration to the interior. Also applies to addition envelope or altered envelope.			
5.507.4.2.1 Documentation of compliance. An acoustical analysis documenting complying interior sound levels shall be prepared by personnel approved by the architect or engineer of record.			

5.507.4.3 Interior sound transmission. Wall and floor-ceiling assemblies separating tenant spaces and tenant spaces and public places shall have an STC of at least 40.			
Outdoor Air Quality			
5.508.1 Ozone depletion and global warming reductions. Installations of HVAC, refrigeration II and fire suppression equipment shall comply with Sections 5.508 .1.1 and 5.508.1.2. as applicable.			
5.508.1.1 CFCs. Install HVAC and refrigeration equipment that does not contain CFCs.			
5.508.1.2 Halons. Install tire suppression equipment that does not contain Halons.			
A5.508.1.3 Hydrochlorofluorocarbons (HCFCs). Install HVAC and refrigeration equipment that does not contain HCFCs.			
A5.508.1.4 Hydrofluorocarbons (HFCs). Install HVAC complying with either of the following: 1. Install HVAC, refrigeration and fire suppression equipment that do not contain HFCs or that do not contain HFCs with a global warming potential greater than 150. 2. Install HVAC and refrigeration equipment that 1irrrit the use of HFC refrigerant through the use of a secondary heat transfer fluid with a global warming potential no greater than 1.			

END OF ATTACHMENT #1

SECTION 01 9113 - GENERAL COMMISSIONING

REQUIREMENTS PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. OPR documentation prepared by University contains requirements that apply to this Section.

C. Related Sections include the following:

1. Division 23 Section "HVAC Commissioning Requirements" for specific requirements for commissioning HVAC systems.
2. Division 26 Section “Electrical Commissioning” for specific requirements for commissioning Electrical systems.

1.2 DEFINITIONS

A. BoD: Basis of Design.

B. CxA: Commissioning Authority.

C. CCxA: Contractor’s Commissioning Agent.

D. OPR: Owner's (University) Project Requirements.

E. Design Builder’s Team:

1. Contractor, Contractor’s Commissioning Agent and subcontractors.

F. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

G. TAB: Testing, Adjusting, and Balancing.

1.3 COMMISSIONING TEAM

A. Members Appointed by the Design Builder and approved by the University’s Representative: Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Design Builder, including Project superintendent, architect and engineering design professionals and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA and CCxA.

B. Members Appointed by University:

1. Representatives of the facility user and operation and maintenance personnel.
2. Architect and engineering design professionals that are not the AE designers of record.

1.4 UNIVERSITY'S RESPONSIBILITIES

A. Select CxA to oversee commissioning process led by CCxA and Design Builder.

B. Coordinate University's operation and maintenance personnel and engineering staff, schedule them to participate in commissioning team activities including, but not limited to, the following:

1. Review and approve final commissioning documentation.

C. Observe and inspect construction and report progress and deficiencies. In addition to compliance with the OPR, BoD, and Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.

1.5 DESIGN BUILDER'S RESPONSIBILITIES

A. Provide utility services required for the commissioning process.

B. Assist CCxA to incorporate LEED Platinum requirements to support Commissioning.

C. Design Builder shall assign representatives with expertise and authority to act on behalf of the Design Builder and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in design-and construction-phase coordination meetings.
2. Participate in maintenance orientation and inspection.
3. Participate in operation and maintenance training sessions.
4. Participate in final review at acceptance meeting.
5. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

D. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in design- and construction-phase coordination meetings.
2. Participate in maintenance orientation and inspection.
3. Participate in procedures meeting for testing.
4. Participate in final review at acceptance meeting.

5. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
6. Provide information to the CxA for developing construction-phase commissioning plan.
7. Participate in training sessions for the University's operation and maintenance personnel.
8. Provide updated Project Record Documents to the CCxA. CCxA will provide to CxA.
9. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 01 Section "Operation and Maintenance Data."
10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.

E. Assemble the final commissioning documentation, including the commissioning report and Project Record Documents.

1.6 CxA'S RESPONSIBILITIES

A. At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals: operation and maintenance training sessions: TAB Work: and Project completion.

B. Attend monthly meetings coordinated by the CCxA.

C. Develop commissioning plan.

D. Manage Cx Alloy.

E. 50% CD review for enhanced commissioning for LEED.

F. Final enhanced commissioning sign off for LEED.

G. Provide test checklist templates to be used in Cx Alloy for the CCxA.

H. Develop measurement and verification plan for CCxA to validate.

I. Submit Measurement and Verification Plan for LEED credit.

J. NRCC Title 24 Review at 95% CD.

K. Incorporate recycled water commissioning into commissioning plan.

L. Design Phase Kick Off Meeting at 65% CD.

M. Construction Phase Kick Off Meeting.

N. For Enhanced Commissioning LEED-EAc3:

1. The CxA must be involved in reviewing the operation of the building with Operations and Maintenance (O&M) staff and occupants within ten months after substantial completion to meet LEEd-EAc3, Enhanced Commissioning Requirements. A plan for resolving outstanding commissioning-related issues must be issued.
2. The CxA must develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems to meet LEED-EAc3 Enhanced Commissioning Requirements.
3. The CxA must review contractor submittals associated with systems being commissioned to meet the LEED-EAc3, Enhanced Commissioning Requirements.

O. Prepare the following documentations:
1. Commissioning Plan Prefinal.
2. Commissioning Plan Final.
3. System Manual for LEED-EAc3 Enhanced Commissioning Requirement
4. Test Checklists and Report Forms (Templates from Cx Alloy)
5. Final Commissioning Report (2 hard copies)

1.7 CONTRACTOR'S COMMISSIONING AGENT QUALIFICATIONS

A. The Contractor's Commissioning Agent (CCxA) shall satisfy the following requirements:

1. Have extensive experience in startup and troubleshooting HVAC, refrigeration, hot water heating, chilled water, steam, plumbing, electrical, emergency power, fire alarm, life safety, laboratory and medical services systems of similar complexity to those contained in these documents;
2. Have excellent working knowledge of complex environmental, fire alarm, and electric power control and facility management systems; be capable of understanding control vendors' operating system and control code; be capable of trouble-shooting control code and recommending necessary modifications;
3. Be competent in system design and intent;
4. Be knowledgeable in test and balance of both air and hydronic system;
5. Have excellent communication and writing skills, be highly organized, and be able to work well with both management and trades contractors.
6. A Bachelors degree in Mechanical Engineering and P.E. certification, with extensive practical field experience, is preferred; however, other technical training and experience with extensive practical field experience will be considered.

B. The CCxA cannot be financially associated with any of the Division 01 through 33 contractors or vendors prior to engaging in this Contract, to avoid potential conflicts of interest.

C. The University's Representative reserves the right to personally interview the CCxA candidate prior to accepting placement in the position. Final approval of the Contractor's Commissioning Agent will be by the University's Representative.

1.8 CCxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Develop the OPR documentation for CxA review.

C. Review and comment on submittals from Design Builder for compliance with the OPR, BoD, Contract Documents, and construction-phase commissioning plan. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the OPR and BoD.

D. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The CCxA shall prepare and distribute minutes to commissioning team members and attendees within three workdays of the commissioning meeting.

E. Prepare Project-specific test procedures and checklists.

F. Schedule, direct, witness, and document tests, and systems startup

G. Compile test data, and certificates and include them in the systems manual and commissioning report

H. Certify date of acceptance and startup for each item for commissioning activities.

I. Review Project Record Documents for accuracy. Request revisions from Design Builder to achieve accuracy. Project Record Documents requirements are spedifed in Division 01 Section “Project Record Documents.”

J. Review and comment on operation and maintenance documentation and systems manual outline for compliance with the OPR, BoD, and Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section "Operation and Maintenance Data

K. Coordinate operation and maintenance training program with the Design Builder to provide qualified instructors to conduct operation and maintenance training. Operation and maintenance training is specified in Diviosn 01 Section “Demonstration and Training.”

L. Video and edit training sessions

M. Prepare final commissioning reports for CxA review

N. Provide commissioning report templates.

O. Suggest commissioning systems that require IOR and Fire Marshal validation. (i.e. fire alarm, smoke evac, etc.)

P. Provide executive summary to CxA for final commissioning report.

1.9 COMMISSIONING DOCUMENTATION

A. Index of Commissioning Documents: CxA shall prepare an index to include storage location of each document with Cx Alloy.

B. OPR: A written document, prepared by the CCxA that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

C. BoD Document: A document, prepared by Design Builder, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

D. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
3. Identification of systems and equipment to be commissioned.
4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
5. Identification of items that must be completed before the next operation can proceed.
6. Description of responsibilities of commissioning team members.
7. Description of observations to be made.
8. Description of requirements for operation and maintenance training, including required training materials.
9. Description of expected performance for systems, subsystems, equipment, and controls.
10. Schedule for commissioning activities with specific dates coordinated with overall construction schedule.
11. Identification of installed systems, subsystems, and equipment, including design changes that occurred during the construction phase.
12. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
13. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
14. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.

E. Test Checklists: the CCxA, with assistance of Design Builder, shall develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Specific checklist content requirements are specified in Division 23 Section "HVAC Commissioning Requirements." Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested item.
2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.
7. Deficiencies.
8. Issue number, if any, generated as the result of test.

F. Certificate of Readiness: Certificate of Readiness shall be signed by Design Builder, Subcontractor(s), Installer(s), and CCxA certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed test checklists signed by the responsible parties shall accompany this certificate.

G. Test and Inspection Reports: CCxA shall record test data, observations, and measurements on test checklists in Cx Alloy. Photographs, forms, and other means appropriate for the application shall be included with data. CCxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

H. Corrective Action Documents: CCxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.

I. Issues Log: CCxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the OPR, BoD, and Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues. All issues to be tracked in Cx Alloy.

1. Creating an Issues Log Entry:

    a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
    b. Assign a descriptive title of the issue.
    c. Identify date and time of the issue.
    d. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
    e. Identify system, subsystem, and equipment to which the issue applies.

f. Identify location of system, subsystem, and equipment.
g. Include information that may be helpful in diagnosing or evaluating the issue.
h. Note recommended corrective action.
i. Identify commissioning team member responsible for corrective action.
j. Identify expected date of correction.
k. Identify person documenting the issue.

2. Documenting Issue Resolution:

a. Log date correction is completed or the issue is resolved.
b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
c. Identify changes to the OPR, BoD, or Contract Documents that may require action.
d. State that correction was completed and system, subsystem, and equipment is ready for retest, if applicable.
e. Identify person(s) who corrected or resolved the issue.
f. Identify person(s) documenting the issue resolution.

3. Issues Log Report: On a periodic basis, but not less than for each commissioning team meeting, CCxA shall prepare a written narrative for review of outstanding issues and a status update of the issues log. As a minimum, CCxA shall include the following information in the issues log and expand it in the narrative:

a. Issue number and title.
b. Date of the identification of the issue.
c. Name of the commissioning team member assigned responsibility for resolution.
d. Expected date of correction.

J. Final Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the OPR, BoD, and Contract Documents. The commissioning report shall include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances in the OPR, BoD, and Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during University's occupancy and operation. It shall describe components and performance that exceed requirements of the OPR, BoD, and Contract Documents and those that do not meet requirements of the OPR, BoD, and Contract Documents. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
2. OPR and BoD documentation.
3. Commissioning plan.
4. Testing plans and reports.
5. Corrective modification documentation.
6. Issues log.
7. Completed test checklists.
8. Listing of off-season test(s) not performed and a schedule for their completion.

K. Systems Manual: CCxA shall gather required information and compile systems manual. Systems manual shall include, but is not limited to, the following:

1. OPR and BoD, including system narratives, schematics, and changes made throughout the Project.
2. Project Record Documents as specified in Division 01 Section "Project Record Documents."
3. Final commissioning plan. (Prepared by CxA.)
4. Final Commissioning report. (Prepared by CxA.)
5. Operation and maintenance data as specified in Division 01 Section "Operation and Maintenance Data." (Prepared by CxA.)

1.10 SUBMITTALS

A. CCxA Qualifications Submittal: Submit the Contractor's Commissioning Agent resume and sample documents in a timely fashion to the University's Representative for approval; which shall include the following:

1. Education and technical training.
2. Present employment:

    a. Company name and address
    b. Present title and job description
    c. History of employment (include dates and positions held)

3. Relevant work experience:

    a. Job name
    b. Position held
    c. Work history (include dates and positions held)

4. Example of prior building commissioning project performed by the proposed CxA

    a. Submitted project shall be similar in commissioning scope and complexity.
    b. Include construction/commissioning schedule developed by proposed CxA
    c. Include test procedures developed by proposed CxA
    d. Include final report prepared by proposed CxA

B. Provided by CxA: CxA shall submit hard copies of prefinal commissioning plan to the Design Builder for review by the Design Builder and their Design Professional. Design Builder shall submit five copies to the University's Representative. Present submittal in sufficient detail to evaluate data collection and arrangement process. One copy, with review comments, will be returned to the CxA for preparation of the final construction-phase commissioning plan.

C. Provided by CxA: CxA shall submit hard copies and electronically formatted information of final commissioning plan to the Design Builder. Design Builder shall submit two hard copies and one disc to the University. The final submittal must address previous review comments. The final submittal shall include a copy of the prefinal submittal review comments along with

a response to each item.

D. Provided by CxA in Cx Alloy: CxA shall submit sample checklists and forms to Design Builder quality-control manager and subcontractors for review and comment. Submit three copies of each checklist and report form.

E. Corrective Action Documents: CxA shall submit corrective action documents pertaining to installation and startup of systems. CxA shall also submit recommendations to better operation and maintenance of the systems, if applicable.

F. CxA shall submit five hard copies of the prefinal commissioning report CxA shall deliver three copies to the University, and one copy to the Design Builder. One copy, with review comments, will be returned to the CxA for preparation of final submittal.

G. CxA shall submit hard copies and electronically formatted information of the final commissioning report. Design Builder shall deliver four hard copies and two set of discs to the University. The final submittal must address previous review comments and shall include a copy of the prefinal submittal review comments along with a response to each item.

1.11 QUALITY ASSURANCE

A. Training Instructor Qualifications: Factory-authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.12 COORDINATION

A. Coordinating Meetings: CxA shall conduct monthly coordination meetings of the commissioning team to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities. Coordination meetings shall start at least 8 months prior to project completion.

B. Pretesting Meetings: CxA shall conduct pretest meetings of the commissioning team to review startup procedures, biweekly testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested. Pretest meetings shall start at least 4 months prior to project completions

C. Testing Coordination: CCxA shall coordinate sequence of testing activities weekly to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

D. Manufacturers' Field Services: CCxA shall coordinate services of manufacturers' field services.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS (FOR COMMISSIONING ITEMS ONLY)

A. Training Preparation Conference: Before operation and maintenance training, CCxA shall convene a training preparation conference to include the University's operation and maintenance personnel, Design Builder, and subcontractors. In addition to requirements specified in Division 01 Section "Demonstration and Training," perform the following:

1. Review the OPR and BoD.
2. Review installed systems, subsystems, and equipment.
3. Review instructor qualifications.
4. Review instructional methods and procedures.
5. Review training module outlines and contents.
6. Review course materials (including operation and maintenance manuals).
7. Inspect and discuss locations and other facilities required for instruction.
8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

B. Training Modules: Develop an instruction program that includes individual training modules for each system, subsystem, and equipment as specified in Division 01 Section "Demonstration and Training."

END OF SECTION 01 9113

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Latest edition of American Concrete Institute, ACI 318 and Manual of Concrete Practice (inclusive of all Parts).

C. If conflict occurs between the Contract Drawings, the Project Manual, ACI 318, and the Manual of Concrete Practice, the most stringent takes precedence.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Sections:

1. Division 03 Section "Architectural Concrete" for general building applications of specially finished and formed concrete.
2. Division 03 Section "Specialty Placed Concrete" for pneumatically placed concrete.
3. Division 03 Section "Site-Cast Concrete" for tilt-up concrete.
4. Division 32 Section "Concrete Paving" for concrete pavement and walks.
5. Division 32 Section "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Architectural Concrete: Concrete that is exposed as an interior or exterior surface in the completed structure and is designated as architectural concrete in the Contract Documents; contributes to visual character of the completed structure and therefore requires special care in the selection of the concrete materials, forming, placing and finishing to obtain the desired architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

C. Reshores: Shores placed snugly under a stripped concrete slab or other structural member after the original forms and shores have been removed from a large area, requiring the new slab or structural member to deflect and support its own weight and existing construction loads to be applied before the installation of the reshores.

D. Shore: Vertical or inclined support members designed to carry the weight of formwork, concrete, and construction loads above.

E. Strength Test: The average of the strengths of at least two 6 by 12 inch cylinders or at least three 4 by 8 inch cylinders made from the same sample of concrete and tested at 28 days or at test age designated for determination of specified compressive strength of concrete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for MR Credit 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Data for IEQ Credit 4.3: For liquid floor treatments, documentation including printed statement of VOC content.
4. Design Mixtures for ID Credit 1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
2. Include qualified strength test records if design mixture is based on field experience.
3. Include results of trial mixtures if design mixture is based on trial mixtures.
4. Include results of modulus of elasticity tests on trial mixtures.
5. Design mixture to be signed and sealed by a professional Civil or Structural Engineer licensed in the State in which the Project is constructed.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installers.

B. Welding certificates.

C. Formwork Shop Drawings: Prepared by or under the supervision of a qualified California registered professional engineer detailing fabrication, assembly, and support of formwork.

D. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Vapor retarders, including subbase materials.
10. Semirigid joint filler.
11. Joint-filler strips.
12. Repair materials.

E. Material Test Reports: For the following, from a qualified Testing Agency, indicating compliance with requirements:

1. Aggregates.

F. ICC ES Evaluation Reports: For evidence of Building Code compliance:

1. Mechanical splices and connectors for reinforcing steel.
2. Slab punching shear resisting system.

G. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

H. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to University's Representative, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent Testing Agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: Cast concrete [slab-on-grade] [and] [formed-surface] panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Design Builder's superintendent.
    b. Independent testing agency responsible for concrete design mixtures and field quality control.
    c. Ready-mix concrete manufacturer.
    d. Concrete and reinforcing steel subcontractors.
    e. University's Representative.
    f. Waterproofing manufacturer's representative.
    g. Flooring product manufacturer's representative for every type of floor covering to be used on the project.
2. Review shall include the following as applicable to the project:

    a. Special inspection and testing and inspecting agency procedures for field quality control.
    b. Concrete finishes and finishing.
    c. Hot-weather concreting procedures.
    d. Curing procedures.
    e. Construction contraction and isolation joints, and joint-filler strips.
    f. Semi-rigid joint fillers.
    g. Forms and form removal limitations.

h. Shoring and reshoring procedures.
i. Vapor-retarder installation.
j. Anchor rod and anchorage device installation tolerances.
k. Steel reinforcement installation.
l. Floor and slab flatness and levelness measurement.
m. Concrete repair procedures.
n. Concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces Furnish full size forms or in sizes indicated on shop drawings.

1. Plywood, metal, or other approved panel materials unless a specific finish is required.
2. Exterior-grade plywood panels ¾-inch thick, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better for glossy finish.
    b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed for matte finish.
    c. Structural 1, B-B or better; mill oiled and edge sealed for exterior textured finish.
    d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed for exterior textured finish.

3. Steel forms shall be true, clean and smooth for concrete surfaces and shall be designed to allow easy removal without damaging placed concrete. Blocking for adjoining units shall be provided to prevent form deflection during placement and compaction.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Structurally sufficient to support weight of plastic concrete and other superimposed loads.

1. Expanded polystyrene (EPS); ASTM C578, Type XI.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, Grade 60 and Grade 80, deformed.

D. Plain-Steel Welded Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Dowel Bar Sleeves: Circular PVC sleeve, sealed one end, dowel bar embedment plus 1 inch in length, and 1/16 inch annular space inside diameter.

C. Deformed Bar Anchors: ASTM A1064/A1064M, deformed steel wire; AWS D1.1/D1.1M, Type C.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

E. Mechanical Splices and Connectors: Comply with ACI 318 and ACI 439.3R, Type I and Type II.

1. Furnish splicing and connector system with current ICC ES Evaluation Report.

F. Punching Shear Reinforcing for Slabs: Comply with ACI 318 and ACI 421.1R.

1. Furnish shear reinforcing system with current ICC ES Evaluation Report

2.4 CONCRETE MATERIALS

A. Regional Materials: Provide concrete that has been manufactured within 500 miles of Project site from aggregates and/or cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C150/C150M, Type I or Type II or Type V. Supplement with the following:

a. Fly Ash: ASTM C618, Class F.

C. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C94M.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260/C260M.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers:

    a. Conspec Marketing & Manufacturing Co., Inc.; a Dayton Superior Company.
    b. Davis Colors.
    c. Scofield, L. M. Company.
    d. Or equal

2. Color: Match University Representative's sample or is not available as selected by University's Representative from manufacturer's full range.

2.6 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Ribbed without center bulb.
2. Dimensions: 6 inches by 3/8-inch thick, nontapered.
3. Manufacturers:

    a. Bometals, Inc.
    b. Greenstreak.
    c. Meadows, W. R., Inc.
    d. Murphy, Paul Plastics Co.
    e. Progress Unlimited, Inc.
    f. Tamms Industries, Inc.
    g. Vinylex Corp.
    h. Or equal.

2.7 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape, minimum 3-inches wide and manufacture's boot system for sealing pipe and conduit penetrations.

1. Products:
    a. W. R. Meadows; Perminator 15 mil.
    b. Stego Industries, LLC; Stego Wrap 15 mil Class A.
    c. Reef Industries, Inc.; Griffolyn 15 mil Green.
    d. Or equal.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C33/C33M for fine aggregates.

2.8 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

1. Products:

a. Anti-Hydro International, Inc.; A-H Alox.
b. L&M Construction Chemicals, Inc.; Grip It AO.
c. Sonneborn, Div. of ChemRex; Frictex NS.
d. Or equal.

B. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

1. Products:

a. Burke by Edoco; NonMetallic Floor Hardener.
b. ChemMasters; Concolor.
c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Conshake 500.
d. Dayton Superior Corporation; Quartz Tuff.
e. Euclid Chemical Company (The); Surflex.
f. L&M Construction Chemicals, Inc.; Quartzplate FF.
g. MBT Protection and Repair, Div. of ChemRex; Maximent.
h. Scofield, L. M. Company; Lithochrome Color Hardener.
i. Symons Corporation, a Dayton Superior Company; Hard Top.
j. Or equal.

2.9 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products:

a. Burke by Edoco; Titan Hard.
b. ChemMasters; Chemisil Plus.
c. ChemTec International; ChemTec One.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
e. Curecrete Distribution Inc.; Ashford Formula.
f. Dayton Superior Corporation; Day-Chem Sure Hard.
g. Euclid Chemical Company (The); Euco Diamond Hard.
h. Meadows, W. R., Inc.; Liqui-Hard.
i. Nox-Crete Products Group, Kinsman Corporation; Duranox.
j. Symons Corporation, a Dayton Superior Company; Buff Hard.

k. US Mix Products Company; US Spec Industraseal.
l. Or equal.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edoco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. L&M Construction Chemicals, Inc.; E-Con.
h. MBT Protection and Repair, Div. of ChemRex; Confilm.
i. Meadows, W. R., Inc.; Sealtight Evapre.
j. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
k. Sika Corporation, Inc.; SikaFilm.
l. Symons Corporation, a Dayton Superior Company; Finishing Aid.
m. Unitex; Pro-Film.
n. US Mix Products Company; US Spec Monofilm ER.
o. Or equal.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

1. Products:
a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. Burke by Edoco; Aqua Resin Cure.
c. ChemMasters; Safe-Cure Clear.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Euclid Chemical Company (The); Kurez DR VOX.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; Aqua Kure-Clear.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100 Clear.
k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.

l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
m. Tamms Industries, Inc.; Horncure WB 30.
n. Unitex; Hydro Cure 309.
o. US Mix Products Company; US Spec Maxcure Resin Clear.
p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
q. Or equal.

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D2240.

C. Reglets: Fabricate reglets in concrete to receive flashing from other trades of not less than 0.022-inch thick galvanized-steel sheet. See Division 07 Section "Sheet Metal Flashing and Trim". Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Provide as shown on Drawings. Hot-dip galvanized-steel sheet, not less than 0.034-inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.

C. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent Testing Agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Modulus of Elasticity: Modulus of elasticity tests (ASTM C469/C469M) shall be performed on laboratory trial mixtures for each concrete strength, each concrete mix design and for each aggregate source. Modulus of elasticity to be tested using servo controlled electromechanical United machines or servo controlled hydraulic Satec machines. Maintain rate of loading to 35 ± 4 psi in lieu of that specified in ASTM C469/C469M.

1. The modulus of elasticity (psi) at 28 days shall be a minimum of 100% of the target modulus of elasticity. Additional modulus of elasticity tests shall be performed on laboratory trial mixtures as follows:

a. Concrete for Mild-Reinforced Slabs: The modulus of elasticity at 7 days or at time of formwork stripping, whichever comes first, shall be a minimum of 90% of the target modulus of elasticity.
b. Concrete for Post-Tensioned Slabs: The modulus of elasticity at 3 days or at time of tendon stressing, whichever comes first, shall be a minimum of 85% of the target modulus of elasticity.

2. Target modulus of elasticity (psi):

a. For $f'_c \leq 6{,}000$ psi: $57{,}000\ (f'_c)^{1/2}$
b. For $f'_c > 6{,}000$ psi: $40{,}000\ (f'_c)^{1/2} + 1x10^6$,
c. f'_c is the specified concrete strength in psi at 28 days.

3. A modulus of elasticity test shall be the average modulus of elasticity from a set of two (minimum) specimens obtained from same sample.
4. Use a qualified independent Testing Agency for preparing and reporting results of modulus of elasticity tests.

C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent maximum

a. Fly ash is not permitted in suspended slabs.

D. Water-soluble chloride ion content shall be determined by ASTM C1218/C1218M at age between 28 and 42 days. Submit documentation verifying compliance. Limit water-soluble, chloride-ion content in hardened concrete to

1. 1.00 percent by weight of cement for mild-reinforced concrete.
2. 0.06 percent by weight of cement for post-tensioned concrete.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Forms shall be used for all concrete, except for sides of footings where neat excavations are possible.

B. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117, unless specified otherwise in the Contract Documents.

D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.
3. Form panels shall be erected with long axis perpendicular to length of framing.
4. Form facings shall butt together.
5. Voids in joints shall be filled with sealant and tooled smooth with surface.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete, unless otherwise indicated on Drawings.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

N. Form Ties

1. Formwork tie plugs shall be minimum ¼” thick lead plugs ½” from the face, at exposed conditions. At non-exposed conditions the plug holes shall be grouted with non-shrink grout to a flush condition.
2. At fire rated conditions, the total tie shall be carefully removed from the concrete. The tie void shall be filled with non-shrink grout and the lead plug placed at exposed conditions.
3. The plastic form tie system shall have a ± ¼” compressible gasket at the end where the tie is connected to the formwork.
4. Locate form ties the will be exposed in a symmetrical pattern, lined up both vertical and horizontally unless another design pattern is desired. Form ties shall typically be placed at least 4-inches from the edge of the panels.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with latest editions of ACI 318, ACI 301, and ACI 347.2R for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. The design of shoring and reshoring systems shall be based on the expected early age concrete strength and stiffness (modulus of elasticity) at the time shoring and reshoring is implemented.

1. For mild-reinforced slabs, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement. Concrete compressive strength at the time of formwork stripping shall be a minimum of 85% of specified f’c (not less than 3,500 psi).

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

1. The age at which removal of shores and reshores can be implemented, and the number of levels reshoring is needed, largely depend on the early age concrete strength and stiffness (modulus of elasticity).
2. The shoring and reshoring design calculations shall explicitly indicate the early age concrete strength and modulus of elasticity used in the shoring and reshoring calculations. The calculations shall indicate both the maximum anticipated stress as well as the maximum anticipated deflection of the all impacted slabs (active slab plus supporting slabs) at the construction stages indicated below:

    a. Immediately after placement of concrete on the active slab.
    b. At the time of formwork stripping and reshoring.
    c. At the time all reshores are removed.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.
2. Seal every penetrating utility, column, and perimeter wall system providing a continuous barrier to moisture penetration or permutation.
3. Provide a minimum of 3-inches of sand below vapor retarder and 2-inches above.

B. Granular Course: Place vapor retarder over 4-inch bed of granular fill, material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

1. Fine-Graded Granular Material: Place and compact a 1/2-inch layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. If not indicated, space vertical joints in walls at 25 feet intervals and 15 feet from corners. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

    a. Perform saw-cutting before concrete starts to cool, as soon as the concrete surface is firm enough not to be torn or damaged by the blade, and before random drying-shrinkage cracks can from in the concrete slab. Joints produced by conventional dry- or wet-cut process shall be made within 4 hours in hot weather and within 12 hours in cold weather after the slab has been finished.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint or use PVC dowel bar sleeve, where indicated.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
2. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the design team and the University's Representative.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Deviation from cross sectional thickness of suspended slabs shall not exceed ±1/4".
5. Deviation from elevation of suspended slabs before removal of supporting shores shall not exceed +3/8" nor -1/4".
6. Slope surfaces uniformly to drains where required.

7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent

formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, or built-up or membrane roofing.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface:

    a. Specified overall values (SOV) of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values (MLV) of flatness, F(F) 20; and of levelness, F(L) 15; for carpeted floors.
    b. Specified overall values (SOV) of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values (MLV) of flatness, F(F) 24; and of levelness, F(L) 17; for surfaces to receive thin-set flooring.
    c. Specified overall values of flatness, F(F) 20; and of levelness, F(L) 15; with minimum local values of flatness, F(F) 15; and of levelness, F(L) 12; for non-critical applications, such as mechanical rooms, non-public areas, surfaces to receive raised flooring or mud-set tile and parking structure slabs.

3. For floor installations 10,000 sq. ft. or less in total project area, finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (90 percent compliance) in accordance to ACI 117 Section 4.8.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lbs./100 sq. ft. of dampened slip-resistive aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aluminum granules.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lbs./100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply liquid to concrete sooner than that recommended by manufacturer.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding

color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
4. Repair technique shall be tested on a mockup or surface to be concealed later, before repairing surfaces exposed to view, for approval by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's and SEOR’s approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's and SEOR’s approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified Testing Agency to perform field tests and inspections and prepare test reports.

B. Inspections: Verify and inspect concrete Work as shown on Drawings.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one random composite sample for each 150 cu. yd. of concrete or 5,000 sq. ft. of surface area of slabs of walls, or fraction thereof, of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M.

    a. Mild-Reinforced and Post-Tensioned Slabs and Beams: Cast and laboratory-cure five standard cylinder plus one spare standard cylinder specimens for each composite sample.

        1) Cast and field-cure additional standard cylinder specimens to verify concrete strength for removal of shoring and reshoring in multistory construction. Number of field-cured cylinder specimens to be determined by Contractor.
        2) Cast and field-cure additional standard cylinder specimens to verify concrete strength for stressing of tendons in post-tensioned construction. Number of field-cured cylinder specimens to be determined by Contractor.

    b. Shear Walls and Columns: Cast and laboratory-cure five standard cylinder plus one spare standard cylinder specimens for each composite sample.
    c. Other Concrete Elements: Cast and laboratory-cure four standard cylinder plus one spare standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.

    a. Mild-Reinforced Concrete Slabs and Beams: Test one laboratory-cured specimen at 4 days; one laboratory-cured specimen at 7 days or upon formwork stripping,

whichever comes first; one laboratory-cured specimen at 14 days; and two laboratory-cured specimens at 28 days.

b. Shear Walls and Columns: Test one laboratory-cured specimen at 7 days, one laboratory-cured specimen at 56 days and one laboratory-cured specimen at 90 days; and two laboratory-cured specimens at 28 days.

c. Other Concrete Elements: Test two laboratory-cured specimens at 7 days and two laboratory-cured specimens at 28 days.

d. A compressive-strength test at shall be the average compressive strength from a set of two specimens obtained from same composite and tested at the age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

   a. If 28-day compressive-strength test falls below satisfactory levels, strength test the spare cylinder at age determined by the Contractor and average with the strength of the 28-day specimens. The average strength of the three cylinders shall be considered one compressive-strength test.

8. Modulus of Elasticity Test Specimens: ASTM C31/C31M.

   a. Mild-Reinforced and Post-Tensioned Slabs and Beams: Cast and field-cure ten standard cylinder specimens plus two spares for each composite sample.

      1) Composite samples (consisting of 12 standard field-cured cylinder specimens) for each concrete strength, each concrete mix design and for each aggregate source, shall be randomly selected from every five floors, with two random composite samples minimum per building.

   b. Shear walls and columns: Cast and field-cure eight two standard cylinder specimens plus two spares for each composite sample.

      1) Composite samples (consisting of 10 standard field-cured cylinder specimens) for each concrete strength, each concrete mix design and for each aggregate source, shall be randomly selected from every five floors, with two random composite samples minimum per building.

9. Modulus of Elasticity Tests: ASTM C469/C469M. Modulus of elasticity to be tested using servo controlled electromechanical United machines or servo controlled hydraulic Satec machines. Maintain rate of loading to 35 ± 4 psi in lieu of that specified in ASTM C469/C469M.

   a. Mild-Reinforced and Post-Tensioned Slabs and Beams: Test two field-cured specimens at 2 days, 4 days, 7 days, 14 days, and 28 days.

   b. Columns and Shear Walls: Test two field-cured specimens at 7 days, 28 days, 56 days, and 90 days.

   c. A modulus of elasticity test shall be the average modulus of elasticity from a set of two specimens obtained from same composite sample and tested at age indicated.

d. If modulus of elasticity of two specimens varies by more than 15% a spare cylinder shall be tested. The average modulus of elasticity of three specimens shall be considered the modulus of elasticity.
e. Modulus of elasticity tests are required for each concrete strength, each concrete mix design and for each aggregate source.

10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing.

    a. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete Testing Agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for each age tested.
    b. Reports of modulus of elasticity tests shall contain Project identification name and number, mix identification number, specimen identification number, curing and environmental history of specimen, date of test, name of Testing Agency, and plot of the results with age of concrete as the abscissa and modulus of elasticity as the ordinate.

11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing Agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing Agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E1155 within 24 hours of finishing. Report results within 72 hours to the University's Representative.

1. To establish the installation's compliance with the specified floor tolerances, floor tolerance compliance tests shall be performed by a testing agency employed by the Design Builder, and defective areas identified.
2. For suspended cast-in-place slabs, test for acceptance shall be conducted before forms and shoring have been removed, so that the effects of deflection and shrinkage on the tolerance data can be minimized.
3. As a practical matter, measurements for suspended slab construction should usually be made within a few hours of slab placement, before the slab begins to be used for staging materials.
4. Remedial measures shall be required:

    a. If the composite value of the entire floor installation measures less than either of the specified overall F numbers, or

b. If any individual section measures less than either of the specified Minimum Local F_F/F_L numbers.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 03 3300.16 - STRATIFIED CONCRETE WALL

PART 1- GENERAL

1.1 GENERAL CONDITIONS

A. Requirements of both General Conditions and General Requirements of Contract apply to work in this Section with same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

A. Furnish materials, labor, transportation, services, and equipment necessary to install Stratified or Sedimentary architectural cast-in-place concrete wall as indicated on Drawings and as specified herein.

B. Work included in this Section:

1. Stratified or Sedimentary architectural cast-in-place concrete walls.

C. Work related in other Sections:

1. Section 02 21 00 – Reinforcing Steel.
2. Section 26 56 29 – Site Lighting.
3. Section 32 13 16 – Decorative Concrete.
4. Section 32 90 00 – Planting.

1.3 REFERENCES AND STANDARDS

A. American Concrete Institute (ACI); www.concrete.org.

1. ACI 117 – *Tolerances for Concrete Construction and Materials*.
2. ACI 301 (reinforcing steel) - *Specifications for Structural Concrete for Buildings.*
3. ACI 304R-00 – *Guide for Measuring, Mixing, Transporting and Placing Concrete*.
4. ACI 305R-99 – *Guide to Hot Weather Concreting*.
5. ACI 306R-10 – *Guide to Cold Weather Concreting.*

6. ACI 308.1-98 - *Standard Specification for Curing Concrete.*

7. ACI 309R-05 – *Guide for Consolidation of Concrete.*

8. ACI 347-01 – *Guide to Formwork for Concrete.*

B. American Society of Testing Materials (AS); www.as.org:

1. AS A184/A184M - *Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement*.

2. AS A615 - *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*.

3. AS C618 Type F - *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*.

4. AS A1064/A1064M - *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete*.

5. AS C33 - *Standard Specification for Concrete Aggregates*.

6. AS C94 - *Standard Specification for Ready-Mixed Concrete*.

7. AS C150 - *Standard Specification for Portland Cement*.

8. AS C172 - *Standard Practice for Sampling Freshly Mixed Concrete*.

9. AS C979/979M - *Standard Specification for Pigments For Internally Colored Concrete*.

10. AS C1077 – *Standard Practice for Agencies Testing Concrete and Concrete Aggregates for use in Concrete and Criteria for Testing Agency Evaluation*.

C. *Design and Control of Concrete Mixtures*, 2013 Edition - Portland Cement Association (PCA); www.cement.org.

D. *Manual of Standard Practices* - Concrete Reinforcing Steel Institute (CRSI); www.crsi.org.

E. *Certification of Ready Mixed Concrete Production Facilities* – National Ready Mix Concrete Association (NRMCA); www.nrmca.org.

1.4 QUALITY ASSURANCE

A. Stratified or Sedimentary Wall Contractor Qualifications:

1. Only qualified architectural concrete contractors experienced in installing Stratified or Sedimentary cast-in-place architectural concrete walls will be allowed to perform work specified under this Section. Acceptance will be based on assessment of installed Stratified or Sedimentary installations and acceptable mock-ups as required under this Section.

2. Provide written evidence indicating successful experience in installing Stratified or Sedimentary on at least (3) projects with a combined installation of at least 100 linear feet. Three (3) of those projects must be located within a 100 mile radius of Project site.

    a. Provide documentation for (3) Stratified or Sedimentary projects containing following information:

        1) (2) photos of each J Stratified or Sedimentary installation to include (1) overall photo and (1) close-up photo taken no more than 3-feet from wall surface.

        2) Project Owner name and telephone number.

        3) Project Architect or Landscape Architect including name and telephone number.

3. Technician and Craftsman:

    a. Technician:

        1) Minimum of (3) projects installing Stratified or Sedimentary.

        2) Technician must be present during critical steps of wall layout, formwork, placement and finishing.

    b. Craftsman:

        1) Minimum of (3) projects installing Stratified or Sedimentary.

B. Ready-Mix Concrete Producer:

1. Ensure that concrete mixes have been designed by a qualified concrete batch plant using standard concrete materials.

2. Confirm that concrete batch plant serving this Project will guarantee in writing that they will single-source their cement, fine aggregate and coarse aggregate, admixtures, and color pigments for each Stratified or Sedimentary type specified on Drawings for duration of Project.

3. Ready-Mix Concrete Producer to comply with AS C94.

4. Ready-Mix Concrete Producer to be certified accordingly to NRMCA's - "*Certification of Ready Mixed Concrete Production Facilities*" requirements.

5. Use of one specific concrete batch plant of a selected concrete mix company is required for each specific Stratified or Sedimentary indicated on Drawings.

C. Pre-Construction or "Kick-Off" Meeting:

1. Attend a Pre-Construction Meeting at last two weeks prior to beginning of Work. Attendees should include representatives from Owner, General Contractor, Construction Manager, Architect, Landscape Architect, and contractors and other trades that will be affected by Stratified or Sedimentary Contractor's work.

2. During this meeting review methods and procedures related to work of this Section, including, but not limited to:

a. Required testing, inspections, reviews, and procedures for approvals.

b. Life safety procedures.

c. Submittals.

d. Information routing protocol.

e. RFI's.

f. Required details and finishes.

g. Required materials, tools, and procedures.

h. Construction schedule and sequencing of work.

i. Construction details.

j. Coordination with other trades and site conditions.

k. Procedures for coping with unfavorable weather conditions.

l. Waste disposal.

m. Testing, inspections, reviews and procedures for approvals.

n. Mock-up requirements including on-site location and size of mock-up.

D. Testing:

1. Owner will incur costs for required tests and inspections. Re-tests and re-inspections will also be paid for by Owner.

2. Concrete Testing Service:

   a. Owner will choose concrete testing agency. If not, a qualified testing agency may be suggested by Stratified or Sedimentary Contractor with related costs borne by Owner.

3. Concrete Batch Plant Tickets:

   a. If requested, provide Owner's Authorized Representative with concrete batch plant tickets for each concrete load delivered. Ensure that each ticket contains at least mix design number, type of cement, fine and coarse aggregates, admixtures, initial mix time, initial quantity of water added, total quantity of water allowed and signature of ready-mix plant dispatcher.

   b. List color additives manufacturer including product name and number.

E. Environmental Conditions:

1. Follow cold weather procedures in accordance with ACI 306R-10. Do not place concrete when ambient temperature is 35 degrees F or lower or is expected to go below that temperature within 24 hours of placement.

2. Follow hot weather procedures in accordance with ACI 305R-99. When air temperatures exceed 90 degrees F, reduce mixing and delivery time to a maximum of 60 minutes. Concrete deliveries made after that time are to be rejected at discretion of Stratified or Sedimentary Contractor.

3. Do not place concrete during rain unless proper protection has been provided. Construct protective covers so as to be self-supporting and braced to support anticipated wind and rain loads. Provide sandbags or other physical barriers to divert runoff from entering onto Work area.

F. Site Conditions:

1. Do not conceal Work until required tests and inspections have been performed and unconcealed Work has been approved by Owner's Authorized Representative.

2. Report major discrepancies between Drawings and actual site conditions to Owner's Authorized Representative prior to beginning Work.

3. Maintain vehicular and pedestrian traffic and provide flagmen, barricades, warning signs, and lights, as required, to facilitate adequate movement of traffic during Stratified or Sedimentary operations.

G. Stratified or Sedimentary Tolerances:

1. Vertical alignment: Does not apply since this is an artistic wall creation. Approved mock-up will set standard for production work.

1.5 SUBMITTALS

A. Product Data:

1. Submit (1) package containing specified products or substitutions proposed to be installed under this Section. Include product cut sheets as required.

B. Certificates:

1. Provide certified mill test reports as to chemical and physical properties of reinforcing bars to be furnished.

C. Statement of Concrete Mix Design:

1. Submit (1) copy of Statement of Concrete Mix Design prepared by concrete batch plant servicing Project for each Stratified or Sedimentary type identified on Drawings. Statement of Concrete Mix Design to contain minimum information as follows:

a. Concrete mix design number.

b. Name, address, and telephone number of batch plant preparing Statement of Concrete Mix Design.

c. Date of mix design report.

d. Project location.

e. Contractor company name requesting concrete.

f. Integral color manufacturer, color name, and dosage rate.

g. Fine and coarse aggregate gradation chart.

h. Material weights, specific gravity, and absolute volumes.

i. Basis of testing such as UBC 2605 D4 or Title 24 2604 D4.

j. Water/cement ratio.

k. Admixtures.

l. PSI rating at 28 days.

m. Specific purpose for this concrete mix design, Example: "Wall Type 1".

n. Signature of testing laboratory manager.

D. Shop Drawings:

1. Submit wall shop drawings containing following information:

a. Location of Stratified or Sedimentary.

b. Locations of construction joints, if any.

c. Top and bottom wall elevations.

d. Embedded select aggregates and stratified layers will be per approved mock-up.

E. Mock-Ups:

1. Construct Stratified or Sedimentary mock-ups as follows:

a. Minimum 5-foot long of each Stratified or Sedimentary type as indicated on Drawings.

b. Construct mock-ups using products, materials and workmanship methods identical to those that will be employed during production.

c. Use same concrete mix that will be used during production.

d. Ensure that same personnel constructing mock-ups will install production work.

e. Construct mock-ups in a pre-approved location.

f. Approved wall mock-ups will be standard for assessment for future production work.

g. Construct additional mock-ups of Stratified or Sedimentary at Contractor's expense if workmanship is responsible for mock-up rejection by Owner Authorized Representative. Contractor will not be

liable for costs incurred to construct additional mock-ups if Owner requests design changes after review of original mock-ups.

h. Protect approved mock-ups during course of Work.

i. Remove mock-ups from site once production of Stratified or Sedimentary has been approved by Owner.

2. Permanent "Mock-Up":

a. As an alternative to producing a 5-foot long Stratified or Sedimentary ™ mock-up, and only if mutually agreed upon between Owner and Stratified or Sedimentary Contractor, construct in-place Stratified or Sedimentary.

b. Permanent "mock-up" will serve as a required mock-up, and, if acceptable to Owner, will become part of completed Work. If not acceptable to Owner demolish, remove and construct a new Stratified or Sedimentary at Stratified or Sedimentary Contractor's expense.

F. LEED Documentation: This project is pursuing LEED certification therefore:

1. Submit material cost breakdowns for products used as part of this Work.

2. Submit additional materials information, i.e. recycled content, manufacturing location, etc.

3. Worksheets where specified in this article or requested by Landscape Architect. Submit Letters of Certification, Product Cut Sheets, Material Safety Data Sheets, or other items to support information when requested by Landscape Architect.

4. Submit Material Safety Data Sheets for applicable products. If MSDS does not show product's Volatile Organic Compound (VOC) content, provide this information through other published product literature from manufacturer, or stated in a letter of certification (on manufacturer's letterhead) from product manufacturer.

5. LEED Credits:

a. Recycled Content Materials: (Credit MR4):

1) Submit product data or other published information indicating separate percentages, by weight, of pre-consumer and post-

consumer recycled content per unit of product. Also include material costs, excluding cost of installation.

2) Include information on Material Tracking Worksheets.

b. Local/Regional Materials: (Credit MR5):

1) Submit location of manufacturing facility including name, address and distance between manufacturing facility and project site.

2) Provide manufacturer's documentation indicating location where base materials were extracted, mined, quarried, harvested, etc. and distance between this location and project site. Include material costs, excluding costs of installation.

3) Include information on Material Tracking Worksheets.

G. Close-Out Documents:

1. (1) copy of Concrete Mix Design for each Stratified or Sedimentary type indicated on Drawings. Having original Concrete Mix Design on record will assist in achieving a closer concrete match to existing walls should Stratified or Sedimentary future wall repairs be required or if additional Stratified or Sedimentary re requested by Owner.

1.6 SUBSTITUTIONS

A. Substitutions to Stratified or Sedimentary will not be allowed.

1.7 PRODUCT HANDLING

A. Store materials in a dry and secure location.

1.8 SITE VERIFICATION

A. Verify site conditions that may affect Work of this Section. Report significant discrepancies between field conditions and Drawings to Owner's Authorized Representative for resolution prior to commencing Work.

1.9 PROJECT CONDITIONS

A. Keep Work area clean and in a safe and workmanlike condition so that rubbish, waste, and debris do not interfere with work of other trades.

B. Ensure that subgrade to receive Stratified or Sedimentary is acceptable prior to beginning Work.

C. Sequencing and Scheduling of Work:

1. Coordinate items that need to be furnished and set in place by other trades prior to beginning Work.

2. Install embedded items or form-outs in wall such as light niches to facilitate work by other trades.

1.10 COORDINATION

A. Notify other Project contractors performing work adjacent to or within Stratified or Sedimentary Contractor's scope of work in ample time, so as to allow sufficient time for them to perform their portion of work.

B. Confirm that electrical conduits and related light fixture niches have been reviewed and approved by Owner prior to placing concrete.

1.11 WARRANTY

A. In addition to manufacturer's guarantees for products installed in conjunction with this Section, warrant Stratified or Sedimentary for a period of (1) year from date of Final Acceptance by Owner against defects in materials, workmanship, and damage caused by Stratified or Sedimentary Contractor's negligence.

B. Stratified or Sedimentary Contractor will not be held responsible for repair of damaged Stratified or Sedimentary during warranty period if damage is caused by damages outside of Stratified or Sedimentary Contractor's control such as trade damage, vandalism, or Acts of God.

PART 2 - PRODUCTS

2.1 READY MIX CONCRETE

A. Batched, mixed and transported in accordance with AS C94.

2.2 PORTLAND CEMENT

A. Refer to Drawings for required cement types.

B. Type I, II/V, or III conforming to AS C150.

C. Use same brand of cement throughout duration of project for each specific Stratified or Sedimentary type.

2.3 FINE AGGREGATE

A. Clean, hard, and durable washed concrete sand conforming to AS C33.

B. Use same fine aggregate from single source throughout duration of Project.

2.4 COARSE AGGREGATE

A. Clean, hard, and durable uniformly graded coarse aggregate conforming to AS C33.

B. Use same coarse aggregate from single source throughout duration of Project.

2.5 WATER

A. Clean, potable, free of deleterious materials such as oils, acids, and organic matter.

2.6 FLY ASH

A. Due to variations in fly ash source locations, fly ash has been known to cause wall section color discrepancies, therefore, Stratified or Sedimentary Contractor will not be responsible to remove and replace mismatched concrete wall sections if fly ash is deemed responsible for color mismatch.

B. Fly Ash conforming to AS C618 – Type F with low carbon content and low loss on ignition, 3 percent or less.

C. Fly ash content not to exceed 25% of total weight of cement.

2.7 ADMIXTURES

A. Color Pigments:

1. Integral Liquid Pigments:

a. Synthetic, color stable, non-fading, mineral oxide pigments conforming to AS C979/C979M.

b. Provide specified pigment colors and manufacturer as indicated on Drawings.

c. Acceptable Manufacturers:

1) Hydrotint® by Davis Colors; www.daviscolors.com.

2) MasterColor® by BASF; www.master-builders-solutions.basf.us/en-us.

3) ColorFlo® by Solomon Colors; www.solomoncolors.com.

4) Chromix® L by Scofield; www.scofield.com/concrete-color-sg.hl

2. Dry Pigments: Not acceptable, unless integral liquid pigment colors are not available in area serving project site. If liquid pigments are not available, use one of the integral liquid pigment manufacturers noted in this section.

B. Concrete Admixture Modifiers:

1. Set Accelerators:

a. Admixture designed to facilitate placement of concrete during cold weather conditions or to provide additional placement time resulting in shortened set time and increased early age PSI strength conforming to AS C494/C494M Type C.

b. Acceptable Manufacturers:

1) MasterSet® AC 122 by BASF; www.master-builders-solutions.basf.us/en-us/products/masterset/2027.

2) Accelguard® 80 by Euclid Chemical Company; www.euclidchemical.com/products/admixtures/set-accelerators/non-chloride/accelguard%C2%AE-80.

3) Polarset® by Grace; www.grace.com.

4) Plastocrete® 161FL by Sika; www.usa.sika.com.

2. Set Retarders:

a. Admixture designed to control concrete set times during hot weather conditions or to extend concrete delivery times. Conforms to AS C494/C494M, Type D.

b. Acceptable Manufacturers:

1) MasterSet® R 122 by BASF; www.master-builders-solutions.basf.us/en-us.

2) Eucon HC® by Euclid Chemical Company; www.euclidchemical.com.

3) Recover® by Grace; www.grace.com.

4) Plasient® by Sika; www.usa.sika.com.

3. Water Reducers:

a. Admixture designed to lower water content in order to achieve greater plasticity, facilitate handling and workability, increase compressive strength, permeability and durability, while reducing aggregate segregation and slab cracking. Conforms to AS C494/C494M Type A and D.

b. Acceptable Manufacturers:

1) MasterPozzolith® 80 by BASF; www.master-builders-solutions.basf.us/en-us.

2) Eucon NW by Euclid Chemical Company; www.euclidchemical.com.

3) WRDA® 64 by Grace; www.grace.com.

4) Plastocrete-10N by Sika; www.usa.sika.com.

2.8 COLOR STAINS

A. Acid-Based Stains:

1. Low odor, low VOC, weather-resistant chemical-based reactive stains.

2. Acceptable Manufacturers:

a. Lithochrome® Chemstain® Classic by Scofield; www.scofield.com.

b. Classic® Acid Stain by Classic Coating Systems; www.classiccoatingsystems.com.

c. Blush-Tone Acid Stain by Brickform; www.brickform.com.

B. Water-Based Stains:

a. Water-based stains manufactured with polymeric emulsion and colorant suitable for exterior concrete surfaces.

b. Acceptable Manufacturers:

1) Color Floor by Smith Paint Products; www.smithpaints.com.

2) SmartColor by NewLook International; www.getnewlook.com.

3) Water Base Stains by Classic Coating Systems; www.classiccoatingsystems.com.

2.9 FORM MATERIALS

A. Plywood:

1. Exterior grade plywood panels, non-absorptive, providing a continuous, true, and smooth surface such as medium-density overlay (MDO), Class 1, or better, with mill-applied release agent and sealed edges.

2. Form Joint Tape: Pressure-sensitive compressible foam tape.

3. Form-Release Agent: Colorless form-release agent that will not bond with concrete surface or impair subsequent treatments of those surfaces.

B. Structural:

1. #2 Construction Grade S4S Douglas Fir minimum 1-1/2-inches thick, free of warping, loose knots, cupping, checks, bows, cracks, and other imperfections that would produce objectionable defects in finished work.

2. Depth of forms to be same depth as concrete being placed.

2.10 REINFORCEMENT

A. Reinforcing Steel:

1. Grade 60 steel conforming to AS A615 and free of rust, dirt, grease or oils.

B. Steel Bar Mats:

1. Grade 60 deformed steel bars assembled with clips conforming to AS A184 and free of rust, dirt, grease or oils.

C. Tie Wire:

1. 16-gauge plain cold-drawn steel conforming to AS A1064/A1064M and free of rust, dirt, grease or oils.

2.11 JOINT MATERIALS

A. Construction Joints:

1. Steel Slip Dowels: 5/8-inch-diameter smooth steel bars, free of dirt, grease, and oils.

2. Plastic Dowel Sleeves: Encase 50 percent of each dowel in a Speed Dowel® plastic alignment sleeve to allow parallel lateral movement of each dowel.

a. Acceptable Manufacturers:

1) Speed Dowel® by Greenstreak Group; www.greenstreak.com.

2.12 CURING COMPOUNDS

A. Liquid, membrane-forming, VOC compliant, curing and evaporation reducer (resin-based dissipating type) to facilitate curing and hardening of freshly placed concrete.

B. Liquid-based curing compounds will not discolor concrete surface and are compatible with concrete sealers.

C. Acceptable Manufacturers:

1. 1100-Clear by WR Meadows; www.wrmeadows.com.

2. Colorful Clear Curing Compound by Admixtures; www.admixtures.biz.

3. Clear Cure by Anti-Hydro Company; www.anti-hydro.com.

2.13 CONCRETE SEALER

A. Low sheen, low VOC, penetrating sealer that exhibits superior resistance to stains, spills, and other contaminates.

B. Acceptable Manufacturers:

1. Repello® by Scofield; www.scofield.com.

2. Siloxene PD® by Prosoco; www.prosoco.com.

3. 511 Impregnator by Miracle Sealants; www.miraclesealants.com.

PART 3 - EXECUTION

3.1 CONCRETE MIX DESIGN

A. Proportion cement, fine aggregate, coarse aggregate, water, color pigment, and admixtures to attain required plasticity and strength in accordance with ACI 304R-00.

B. Concrete Mix Design Criteria:

1. Slump Range:

a. Minimum: 4-inches.

b. Maximum: 6-inches.

c. Slump differential between successive batches: 1-inch.

2. Compressive Strength:

a. In 7 days – minimum 1,800 psi.

b. In 28 days – minimum 3,000 psi.

3. Cement:

a. Type: As indicated on Drawings.

b. Quantity per cubic yard of concrete mix:

1) Minimum: 6 sacks.

2) Maximum: 7 ½ sacks.

4. Water/Cement (W/C) ratio:

a. Minimum: 0.45.

b. Maximum: 0.60.

5. Chloride content of the entire mix shall not exceed 0.06 percent by volume.

6. Fine Aggregate:

a. No less than 35% of volume with a maximum of 50% of sum of separate fine and coarse aggregate volumes.

7. Coarse Aggregate:

a. No less than 65% of volume with a maximum of 50% of sum of separate fine and coarse aggregate volumes.

8. Admixtures:

a. Air entrainment: Do not exceed 2%.

b. Shrinkage Reducers: Do not exceed 2% of total cement weight.

9. Fly Ash:

a. Do not exceed 25% of total cement weight.

10. Accelerators:

a. Use accelerators with caution and do not use calcium chloride accelerators due to potential corrosion of steel reinforcement.

11. Concrete Delivery:

a. Do not use concrete loads that have exceeding 90 minutes from time of batching to jobsite delivery.

3.1 SUBGRADE PREPARATION

A. Prior to placing concrete footing confirm following with Owner, Project geotechnical engineer, general contractor, or other responsible party that:

1. Subgrade is in conformance with requirements contained in Project's geotechnical soils report and Drawings.

2. Subgrade is free of compressible or expansive soils, exposed rocks, loose soil, and debris.

3. Subgrade pre-saturation has been performed and resulting data meets Project geotechnical engineer's approval prior to placing concrete.

4. Utilities in Stratified or Sedimentary ™ are in place and approved by Owner's Authorized Representative prior to placing concrete.

5. Owner's Authorized Representative has approved subgrade and conditions noted above prior to placing of concrete.

3.2 FORMWORK

A. Decorative Concrete Contractor is responsible for design, engineering, and construction of formwork necessary to install its Work under this section.

B. Review Drawings then provide necessary recesses and openings of proper sizes and shapes to accommodate required embeds. Secure anchor plates, inserts, and other items to be embedded in concrete as provided by others, accurately so that they will not be displaced during concrete placement.

C. Formwork to comply with ACI 347-01.

D. Construct formwork of sufficient thickness and joint tightness so deformation and concrete seepage will not occur during concrete placement. Hold formwork securely in-place with stakes, clamps, spreaders or braces to ensure formwork will be stable during concrete placement.

E. Construct forms in such a manner that construction joints occur at locations indicated on Paving Jointing Plan.

F. Coat plywood forms with form-release agent prior to concrete placement to ensure separation from concrete without damage to concrete.

G. Install formwork using a digital electronic transit for formwork layout accuracy.

H. Butt tight joints in forming materials and bear on solid construction. Carefully form bevels, grooves and recesses to form neat and straight lines.

I. Set forms to meet alignment, shape, dimensions and grades as indicated on Drawings.

J. Build temporary bulkheads and key as required. Securely brace at planned locations of construction joints.

K. Construct straight formwork true, plumb with limited deviation.

L. Space column clamps, wall ties, form hangers and other structural accessories for forms so that their working capacities are not exceeded by loads imposed by concrete and by concreting operations.

M. Construct radial formwork concentric with smooth transitions to adjoining straight sections.

N. Should misalignment of forms, excessive deflection of forms, or displacement of reinforcing occur during concrete placement, take corrective measures immediately, to extent, if necessary, that placing operations be stopped and concrete removed from within

forms. Corrective measures to be such as to ensure acceptable lines and surfaces to required dimensions and cross sections.

O. Notify Owner's Authorized Representative at least 48 hours in advance of completion of formwork and obtain Owner's Authorized Representative approval of formwork layout prior to concrete placement.

P. Allow formwork to remain in place long enough for concrete to set properly. Remove formwork when appropriate and discard offsite.

3.3 REINFORCEMENT

A. Prior to placement of reinforcement steel, clean off loose mill scale, dirt, and other bond-reducing materials.

B. Place reinforcement in size and spacing as indicated on Drawings and maintain specified concrete cover over reinforcement.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers.

D. Obtain Inspector’s approval of reinforcing steel placement prior to placing concrete.

3.4 FORM TIES

A. Exposed form ties will not be visible once Stratified or Sedimentary ™ is architecturally finished, however, form ties will still be required to construct wall.

B. Internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete upon removal. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2-inches from the architectural concrete surface.

C. Form ties to have a minimum working strength when fully assembled of at least 3,000 lbs.

D. Adjust form ties in length so as to permit complete tightening of forms and of such type as to lean no metal closer than 1-inch to an exterior surface or closer than ½-inch to an interior surface.

E. Do not fit form ties with lugs, cones, washers, or other device so as to act as a spreader within forms, or for other purposes that will leave a hole or depression larger than 7/8-inch in diameter back of exposed surface of concrete.

F. Do not use wire or wood ties.

G. Coat ties that are to be pulled from walls with cup grease or other approved material to facilitate efficient removal.

H. Loosen tie rods that are to be entirely removed from walls 24 hours after concrete is poured. Remove all but a sufficient number of ties to hold forms in place.

3.5 CONCRETE PLACEMENT

A. Place concrete in conformance to ACI 304R-00 – *Guide for Measuring, Mixing, Transporting and Placing Concrete*.

B. Use only approved concrete mix designs.

C. Obtain Owner's Authorized Representative's approval of formwork prior to placing concrete.

D. Prior to placing concrete, clean areas to receive concrete. Where areas are inaccessible to hand cleaning, blow with compressed air.

E. Coordinate placement of concrete with adjacent trades.

F. Deliver and discharge concrete form truck within 90 minutes hours after introduction of water or within 300 revolutions of concrete truck drum.

G. Do not add water to concrete during delivery or placement, however, to obtain specified slump, additional water may be added to concrete before placement provided that added water will not exceed total amount of water allowed as stated on delivery ticket.

H. Place concrete no faster than it can be properly placed and finished with due regard to weather, temperature size and abilities of finishing crew.

I. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness.

J. If a section cannot be placed continuously, provide a construction joint.

K. Screed top surface of wall with a straightedge then strike-off to meet specified top of wall elevations.

L. After bleed water has evaporated, tool required top joints and edges and apply a surface finish as indicated on Drawings.

M. If concrete is to be pumped instead of tailgating, protect adjacent paving or other improvements by supporting concrete pump hose and its metal connections on plywood, sand bags, or other suitable material.

N. Consolidate concrete by mechanical vibration supplemented by hand spading, rodding, and tamping. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use equipment and procedures to consolidate concrete complying with ACI 309R-05 – *Guide for Consolidation of Concrete*.

O. Cold-Weather Concrete Placement: When air temperature has fallen to or is expected to fall below 40 degrees F, comply with provisions of ACI 306R-10 – *Guide to Cold Weather Concreting* and as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

2. Uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement.

3. Do not use frozen materials or materials containing ice or frost. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

P. Hot-Weather Concrete Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R-99 – *Guide to Hot Weather Concreting* and as follows:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 degrees F. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions.

3.6 FINISHING OF STRATIFIED OR SEDIMENTARY ™

A. Since Stratified or Sedimentary ™ is in essence a custom art piece; typical finishing textures are not expected. Finishes on both horizontal and vertical surfaces are too closely match those approved in original mock-up.

B. At time of Stratified or Sedimentary ™ finishing, it would be strongly recommended to have original Stratified or Sedimentary ™ designer present on-site to oversee the design expression of wall exposure, stratification layer variations, etc.

C. If color stains are required on some stratification layers, apply only per manufacturer's directions.

3.7 REMOVAL OF FORMWORK

A. Remove formwork only when concrete is self-supporting but still allows for trowelling of surface. Timely removal of wall forms is essential in order to facilitate final finishing of Stratified or Sedimentary ™.

3.8 JOINTING

A. Locate and construct wall joints as indicated on Drawings or as noted on approved Stratified or Sedimentary ™ Contractor's shop drawings.

B. Construct wall joints true to line with faces perpendicular to surface plane of wall surface.

C. Install joints that match approved mock-up.

D. Contraction Joints:

1. Provide sawcut contraction joints as soon as concrete has sufficient strength to support sawing equipment and reduce joint edge spalling. The goal is too sawcut wall prior to developing random wall cracking but before edge spalling is apparent. Cut wall no more than 24 hours after concrete placement.

2. Ensure that diamond blade is new or in a condition to provide a strait and unspalled edge.

3. Saw cut joints to specified width and depth.

3.9 CURING

A. Cure concrete immediately after wall placement. Protect wall from premature drying, hot and cold temperatures, wind, rain, flowing water and mechanical injury.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep concrete continuously moist for not less than 7 days.

C. Cure concrete per ACI 308.1-98. Use one of following methods that will not mottle, discolor, or stain concrete surface being cured:

1. Water Curing:

a. Keep concrete surface continuously wet by covering with water.

b. Use continuous water-fog spray.

c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.

d. Immediately repair holes or tears during curing period using cover.

2. Chemical Liquid Curing:

a. Apply liquid curing compound uniformly in continuous operation by spray or roller according to manufacturer's directions.

b. Recoat areas subjected to heavy rainfall within 3 hours after initial application.

3. Curing Blankets:

a. Water saturate curing blankets and keep continuously wet. Lap joints and seal with water-resistant pressure-sensitive tape.

b. Seal perimeter edges and penetrations with 12-inch laps.

c. Ensure that curing blankets are kept flat on concrete surface.

d. Maintain curing blankets for minimum 7 days.

D. Do not allow concrete surface to alternate between wet and dry during curing period.

E. Do not permit debris or other materials to be placed on wall surface during curing period.

3.10 STAINING AND SEALING

A. Allow Stratified or Sedimentary ™ to dry sufficiently before applying specified stain or sealer.

B. Do not apply sealer if air temperatures are below 50 degree F or above 90 degrees F.

C. Once the concrete surface has been sealed, protect surface until fully dried.

D. Follow manufacturer's directions for stain or sealer application.

3.11 CONCRETE REPAIR

A. The Stratified or Sedimentary ™ finish effectively hides bugholes, spalls, and pockmarks so repair is not normally required.

B. Stratified or Sedimentary ™ Contractor will repair or replace Stratified or Sedimentary ™ at its own expense if determined to be defective and/or not meet minimum requirements set forth in this Section.

C. Perform structural repairs only with prior approval of Owner's Authorized Representative for method and procedure, using specified epoxy adhesive and mortar.

3.12 PROTECTION

A. Owner or General Contractor is responsible to protect completed Stratified or Sedimentary ™.

B. Protect wall surfaces, especially edges and top surface from trade damage.

C. Clean Stratified or Sedimentary ™ not more than one day prior to Final Acceptance Walkthrough.

3.13 CLEANUP

A. Keep Work area clean, neat and orderly throughout duration of project.

B. Prior to Final Acceptance by Owner's Authorized Representative, cleanup and remove deleterious materials and debris from Work area.

END OF SECTION

SECTION 03 3300 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

1. Form Liners.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Division 07 Section "Joint Sealants" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

1.3 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:
    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.

d. Cast-in-place architectural concrete subcontractor.

2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4.1[and Credit MR 4.2]: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements and for equivalent concrete mixtures that do not contain portland cement replacements.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

E. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

F. Samples: For each of the following materials:

1. Form-facing panel.

2. Form ties.

3. Form liners.

4. Coarse- and fine-aggregate gradations.

5. Chamfers and rustications.

G. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18 by 18 by 2 inches (450 by 450 by 50 mm), of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Repair materials.

C. Material Test Reports: For the following, by a qualified testing agency:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 6, "Architectural Concrete."
2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches (1200 by 1200 by 150 mm) minimum, to demonstrate the expected range of finish, color, and texture variations.

G. Mockups: Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
3. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
4. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
5. Obtain Architect's approval of mockups before casting architectural concrete.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
7. Comply and coordinate with requirements of Section 01 4339 "Exterior Walls Mockups".

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Form-Facing Panels for As-Cast Finishes: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

C. Form Liners: Units of face design, texture, arrangement, and configuration to match design reference sample. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

1. Spec Formliners, Inc.: Standard Spec Sawtooth 1771, ElastoSpec 100% solid urethane bonded to 3/4" plywood.
2. Spec Formliners, Inc: Rough Cedar Plank 1254, ElastoSpec 100% solid urethane bonded to 3/4" plywood.

D. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch thick.

E. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS, that adheres to form joint substrates.

F. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

G. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, internally disconnecting ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches (38 mm) from the architectural concrete surface.

2.2 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."

1. Where legs of wire bar supports contact forms, use CRSI Class 1, gray, plastic-protected bar supports.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I , Type II or Type V, gray . Supplement with the following:

a. Fly Ash: ASTM C 618, Class F. Maximum 25% of total cementitious material for Class C and 20% of total cementitious material for Class F. Minimum amount of fly ash, when used 15% of total cementitious material.

B. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm).
2. Gradation: Uniformly graded.

C. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable,[free of carbon black,] nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Waterborne, Membrane-Forming Curing Compound: ASTM C 156.

2.6 REPAIR MATERIALS

A. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.

B. Refer to Section 03 3000 for mixes.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

D. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.

2. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.

B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm).

D. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.

1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
2. Do not use rust-stained steel form-facing material.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of cast-in-place architectural concrete.

H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

M. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 REINFORCEMENT AND INSERTS

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Schedule form removal to maintain surface appearance that matches approved field sample panels.
2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.

B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by design team or university representative.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 FINISHES, GENERAL

A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete continuously moist for no fewer than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for no fewer than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
3. Curing Compound: Install per manufacturer's recommendations. Maintain continuity of coating and repair damage during curing period.

3.9 FIELD QUALITY CONTROL

A. General: Comply with field quality-control requirements in Division 03 Section "Cast-in-Place Concrete."

3.10 REPAIRS, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
   1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.

B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

E. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.
   1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION

SECTION 03 4500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Architectural precast concrete sills and trim elements. .

B. Related Sections include the following:

1. Section 03 3000 "Cast-In-Place Concrete" for installing connection anchors in concrete.
2. Section 05 1200 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
3. Section 05 5000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.

1.3 DEFINITION

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Loads: As indicated.
2. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
   a. Upward and downward movement of 1/2 inch.
3. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

D. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.

1. Indicate separate face and backup mixture locations and thicknesses.
2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
5. Include plans and elevations showing unit location and sequence of erection for special conditions.
6. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
7. Indicate relationship of architectural precast concrete units to adjacent materials.
8. Indicate locations and details of brick units, including corner units and special shapes, and joint treatment.
9. Indicate locations and details of stone facings, anchors, and joint widths.
10. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
11. Comprehensive engineering analysis [signed and sealed] [certified] by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

E. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer fabricator.

B. Welding certificates.

C. Material Certificates: For the following items, signed by manufacturers:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.

D. Material Test Reports: For aggregates.

E. Source quality-control test reports.

F. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load -bearing members.

B. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project before erection of precast concrete and who can produce an Erectors' Post-Audit Declaration.

C. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Participates in PCI's plant certification program at time of bidding and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units or participates in APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and is designated an APA-certified plant.

D. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

F. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."

G. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of 2 sample panels approximately 16 sq. ft. in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.

1. Locate panels where indicated or, if not indicated, as directed by Architect.

2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.

3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.

H. Mockups: After sample panel approval but before production of architectural precast concrete units, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup as indicated on Drawings including and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.

2. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by Architect in writing.

4. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management And Coordination."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.

F. Lift and support units only at designated points shown on Shop Drawings.

1.9 SEQUENCING

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Fabricators: Subject to compliance with requirements, fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:

2.2 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.3 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.

a. Gradation: Uniformly graded.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.

D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

2.5 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

B. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.

1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.6 ACCESSORIES

A. Precast Accessories: Provide stainless steel clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.7 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Limit use of fly ash and silica fume to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's optionby either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi minimum.

2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.9 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished work.

2. Edge and Corner Treatment: Uniformly chamfered.

2.10 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.

2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.

3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

D. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.

E. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

F. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

G. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.

H. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

I. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

J. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

K. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.11 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances:

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
   a. 10 feet or under, plus or minus 1/8 inch.
   b. 10 to 20 feet, plus 1/8 inch, minus 3/16 inch.
   c. 20 to 40 feet, plus or minus 1/4 inch.
2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:
   a. 10 feet or under, plus or minus 1/4 inch.
   b. 10 to 20 feet, plus 1/4 inch, minus 3/8 inch.
   c. 20 to 40 feet, plus or minus 3/8 inch.
3. Local Smoothness: 1/4 inch per 10 feet.
4. Warping: 1/16 inch per 12 inches of distance from nearest adjacent corner.

C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Weld Plates: Plus or minus 1 inch.
2. Inserts: Plus or minus 1/2 inch.
3. Handling Devices: Plus or minus 3 inches.
4. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch.

2.12 FINISHES

A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved and as follows:

1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
2. As-Cast Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs.

B. Finish exposed top bottom and back surfaces of architectural precast concrete units to match face-surface finish.

C. Finish unexposed surfaces of architectural precast concrete units by float finish.

2.13 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

C. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.

1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
2. Cores will be tested in an air-dry condition.
3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
    a. Project identification name and number.
    b. Date when tests were performed.
    c. Name of precast concrete fabricator.
    d. Name of concrete testing agency.

e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
4. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
5. Remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

B. Erect architectural precast concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:

1. Erection of precast concrete members.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.

D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

SECTION 04 2000 - UNIT MASONRY

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Masonry shown on the Structural Drawings.

a. Furnish and lay concrete masonry units.
b. Furnish and place reinforcing steel.
c. Provide mortar, grout and grouting.
d. Place bolts, anchors, hardware, metal frames and other insert items.
e. Cure, protect and clean finish work

B. Products installed but not furnished under this section:

1. Bolts and Lintels, Section 05500 Metal Fabrications.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 01300-Submittals: Shop Drawings, Product Data and Samples:

1. Product Data for masonry anchors, accessories and flashing.

a. Submit manufacturer's specifications and installation instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as specified.

2. Grout mix design.
3. Shop Drawings, where masonry reinforcement is shown on Structural Drawings: Submit bending and placement schedules and diagrams, showing size, grade and quantity. Include mill test reports as required in Section 03200 Concrete Reinforcement.
4. Samples for verification purposes of the following materials:

a. Mortar samples showing the full range of color to be expected, for verification.

B. Masonry Unit Quality: For information and record, certify compliance of each type of unit with Specification requirements. Submittal will not be returned unless an error is observed.

C. Test Reports: For information and record, submit reports for tests on each type of masonry unit performed by an independent laboratory. Include results of all tests required by standards specified. Submittal will not be returned unless an error is observed.

1.3 QUALITY ASSURANCE

A. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for

each different product required for each continuous surface or visually related surfaces.

B. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

C. Field Constructed Mock Ups: Prior to installation of masonry work, erect sample wall panels to 1) further verify selection made for color and textural characteristics, tentatively made under sample submittals of masonry units and mortar, and 2) to represent completed masonry work for qualities of appearance, materials and construction. Build mockups approximately 10' long by 10' high by full thickness, including face and back-up wythes as well as accessories. Include exterior corner, reveals, and portion of window surround (sill, jamb and head), soldier course, and dogtooth course incorporated in these areas.

D. Lay up one complete bay of brick one story high, wash down and remove scaffolding. If accepted, bay may remain as finished wall. Demolish if rejected. Allow seven days after mortar is cured for review before proceeding with other brick work.

E. Quality Control Testing: Initial testing of concrete unit masonry will be provided by the Contractor's Independent Testing/Inspection Laboratory, as described in Section 01400. Notify the University's Representative and the testing laboratory 24 hours before grouting vertical cells. Cooperate in the taking of specimens and testing. Provide facilities for site curing of test specimens.

F. Procedures to Minimize Efflorescence: Select cementitious products and admixtures with history of successful use. Avoid "shelves" in cavities.

G. Design modifications may be made only as necessary to meet field conditions and to ensure proper fitting of the work, and only as acceptable to University's Representative. Maintain general design concept shown without increasing or decreasing sizes of members or altering profiles and alignment shown.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store masonry units above ground on level platforms or pallets which allow air circulation under stacked units.

B. Cover and protect masonry units against wetting prior to use.

C. Store mortar materials under cover in a dry place.

1.5 PROJECT CONDITIONS

A. Before beginning the masonry and associated work, the subcontractor with masonry foreman shall meet at the project site with the Contractor's superintendent, the installer of each component of the associated work, the representative of the brick manufacturer, installers of other work requiring coordination with the masonry work and the University's Representative.

1. Review the material selections and procedures to be followed in performing the work in compliance with the requirements specified.
2. Repeat the conference if either the masonry foreman or Contractor's superintendent are replaced

before completion of work of this Section.

B. Staining: Prevent grout or mortar from staining the face of masonry to be left exposed, or painted.

1. Remove immediately grout or mortar in contact with face of such masonry.
2. Protect sills, ledges and projections from droppings of mortar. Protect door jambs and corners from damage during construction.

C. Hot Weather Conditions: Protect masonry construction from direct exposure to wind and sun when erected in an ambient air temperature of 90° F. in the shade with relative humidity less then 50%.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Hollow Load Bearing Units:

1. ASTM C 90, Grade N, Type 1.
2. Nominal Face Dimensions: 8" x 16", typical. Provide other sizes as shown or required.

B. Provide medium weight aggregate units using a blend of ASTM C 33 and C 331 aggregates as required to produce an equivalent weight between 105 and 110 lbs. per cubic foot.

C. Maximum Drying Shrinkage Class: 0.045% as determined by ASTM C 426.

2.2 MORTAR AND GROUT, WALLS

A. Mortar: Comply with ASTM C 270, except use only Type 1 portland cement and water that is clean and fit to drink.

1. Proportion mortar for brick in accordance with Type N requirements (1-1-6), 28 day compressive strength 750 psi.
2. Proportion mortar for concrete masonry in accordance with Type S requirements (1-1/2-4), 28 day compressive strength 1800 psi.

B. Grout:

1. Comply with ASTM C 476 "Grout for Reinforced and Nonreinforced Masonry", type "Coarse."
2. Provide 28-day compressive strength of 2000 psi. Proportions: 1 part portland cement, 0 to 1/10 part hydrated lime or lime putty, fine aggregate amounting to 2-1/4 to 3 times the volume of the cement, and coarse aggregate amounting to 1 to 2 times the volume of the cement.
3. Admixture for Grout: Sika (RR-23360) "Grout Aid Type II" or equal (no known equal). Provide in all grout.

C. At exterior walls, add AC Horn (RR-02541) "Hydratite Plus" or equal (no known equal), at the rate of 2 pounds per sack of cement.

D. Mixing Mortar and Grout: Mix for at least 5 minutes in a mechanical batch mixer with slump of 8" to 10" (10-1/2" to 11" at partition walls). When mortar begins to stiffen from evaporation or absorption of

a part of the mixing water, retemper the mortar by adding water and remixing.

E. Use mortar and grout within 90 minutes of addition of water to portland cement.

F. Grout solid hollow metal frames and other indicated items in masonry.

2.3 PAVER SETTING AND GROUTING MATERIALS AND MIXES

A. Materials for installing and grouting pavers shall be portland cement/sand mortar gage and Laticrete 4237 Latex Thin Set Mortar Additive and Laticrete 3701 Grout and Mortar Admix.

1. Masonry Cement: ASTM C 91 Type 2
2. Portland Cement: ASTM C 150, Type 1
3. Sand: Masons sand ASTM C 144, concrete sand ASTM C 33 and bagged 30-60 Mesh Silica. Mason sand will not be allowed in setting bed.
4. Latex Additives: Laticrete 4237 Latex Thin Set Mortar Additive and Laticrete 3701 Grout and Mortar Admix. Install in accordance with the manufacturer's instructions for thick bed installation.
5. Other Manufacturers: Conform to requirements of Section 01640, Product Options and Substitutions.

B. Bedding and grouting mortars shall be weather, frost, shock and chemical resistant and shall meet the following physical requirements:

1.	Compressive Strength: Thick Bed Mortar	3000 psi Minimum
2.	Paver Bond Strength:	500 psi Minimum
3.	Water Absorption:	4.0% Maximum

C. The finished mortar and grout shall be resistant to urine, dilute acid, dilute alkali, sugar, brine and food waste products.

D. Mortar additives shall be compatible and from a single manufacturer.

E. The addition of water or other materials to dilute the mortar additive on the job site will not be permitted.

F. Slurry Bond Coat:

1. One bag (94 lb) portland cement, one bag 30 mesh sand.
2. Five gallons Laticrete 4237 (adjust quantity of liquid to obtain proper consistency).

G. Latex 5Grout:

1. ASTM C 270, Type M.
2. Laticrete 3701 Admix (adjust quantity of liquid to obtain proper consistency).

H. Thick Bed Mortar (2”, Plus or Minus):

1. One bag (94 lb) portland cement.
2. Four cubic feet coarse sand ASTM C 33.
3. Laticrete 3701 Admix (adjust quantity of liquid to obtain proper consistency, approximately 2-3

gallons).

2.4 REINFORCEMENT

A. Cold-Drawn Steel Wire: ASTM A 82.

B. Welded Steel Wire Fabric: ASTM A 185.

C. Billet Steel Deformed Bars: ASTM A 615.

D. Truss Type: Dur-O-Wal (RR-24401) or K-Web, 2" less in width than nominal wall thickness.

E. Centering Devices: Factory fabricate from steel wire meeting ASTM A 82. Form wire devices from wire that has been zinc coated in accordance with ASTM A 116, Class 1. Form centering clips from wire not lighter than 9 gage. Provide clips of a design that will prevent displacement of the reinforcing bars during construction or grouting.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify tolerances of adjoining materials before beginning work, including alignment with plan dimensions. Commencement of masonry indicates acceptance of surrounding conditions.

B. Wetting Brick:

1. Wet brick with absorption rates in excess of 20g./30 sq.in. minimum.
2. Recommended procedure to insure that brick are nearly saturated, but surface dry when laid, is to play a hose on the pile of brick until the water runs from the pile. This should be done one day before brick are to be used. In extremely warm weather, play hose on pile several hours before brick are to be used.
3. Field check by depositing a quantity of water on the flat side of the brick to wet an area approximately the size of a quarter coin. If the water disappears in less than 15 seconds, wet the brick.

C. Cleaning Reinforcement: Before being placed, remove loose rust and other coatings from reinforcement.

D. Lay only dry concrete masonry units.

3.2 GENERAL ERECTION REQUIREMENTS

A. Pattern Bond:

1. Lay exposed concrete masonry units in one-third running bond with vertical joints located at a third point of unit in course below to create a directional (rising or falling) pattern as indicated.
2. Employ additional patterns (soldier, sailor, dogtooth, stacked bond) where indicated .
3. Bond unexposed masonry units in a wythe with standard running bond.

B. Joining of Work:

1. Where Fresh Masonry Joins Partially Set Masonry:

   a. Remove loose masonry units and mortar.
   b. Clean and lightly wet exposed surface of set masonry.

2. Stop off horizontal run of masonry by racking back 1/2 length of unit in each course.

C. Tooling:

1. Tool exposed joints when "thumb-print" hard with a round jointer, slightly larger than joint width, then wipe with burlap to present sandy finish.
2. Concave-tool exterior joints below grade.
3. Flush cut all joints not tooled.
4. Slope joints in window sills and other similar exposed joints to exterior; strike with hard tool finish.

D. Shelf Angles and Lintels: Adjust to keep masonry level and at proper elevation.

E. Flashing:

1. Clean surface of masonry, make smooth and free from projections.
2. Set fabric flashing in bed of fibered asphalt plastic cement as recommended by flashing manufacturer; overlap and seal joints.
3. Anchor top of flashing with stainless steel straps; anchor straps to each stud through gypsum sheathing or to concrete masonry units with corrosion resistant anchors not more than 16” on center.
4. At CMU provide bead of asphalt plastic cement above strap.

F.Weep Holes:

l. Provide weep holes in head joints of first course immediately above finished grade or flashing and at other locations indicated. Insert short length of rope of diameter as directed; remove when tooling joints. Leave head joint open, free of mortar, and clean.
2. Space 24” o.c. or as indicated.
3. Keep weep holes and area above flashing free of mortar and other obstructions.
4. Fill cavity behind weeps with pea gravel at least 4” high.

G. Sealant Recesses: Leave joints around outside perimeters of doors, windows, and other wall openings as indicated.

H. Cutting: Cut exposed masonry units with motor-driven saw.

J. Built-In Work:

1. Avoid cutting and patching.
2. Install bolts, anchors, nailing blocks, inserts, frames, vents, flashings, conduit, and other built-in items as masonry work progresses.
3. Solidly grout spaces around built-in items.

K. Chases:

1. Build chases in, do not cut.
2. Minimum Installation Distance from Jambs of Openings: One masonry unit length.

L. At veneer walls, lay inner wythe first.

1. Allow sufficient time for dampproofing to be placed, cured, and observed before placing outer wythe.
2. Remove excess mortar from cavity wall ties before allowing application of dampproofing. Fill voids at the ties and mortar joints.

M. Where dampproofing is indicated, provide a waterproof membrane to prevent the entrance of water into the building, including masonry, dampproofing, and flashing. Take care to coordinate all work and to protect dampproofing and flashing until the masonry work is complete.

3.3 CONCRETE UNIT MASONRY

A. Set units plumb, true to line and level courses accurately spaced.

B. Mortar Beds:

1. Lay with full mortar coverage on horizontal and vertical face shells.
2. Provide full mortar coverage on horizontal and vertical face shells and webs in all courses adjacent to cells or cavities to be filled with grout.

C. Horizontal and Vertical Face Joints:

1. Nominal Thickness: 3/8”.
2. Construct with uniform joints.
3. Shove vertical joints tight.
4. Strike joints flush in surfaces to be covered with other masonry, or other surface applied finish other than paint.
5. Tool joints in exposed or to be painted surfaces when thumb-print hard with a round jointer.
6. Remove mortar protruding into cells of cavities to be reinforced or filled.
7. Fill horizontal joints with mortar between top of masonry partitions and underside of concrete slabs or beams.

D. Placing R5einforcement: Position metal reinforcement accurately and secure against displacement with tie wire.

1. Spacing: Minimum clear distance between longitudinal bars, nominal diameter of bar or 1”.
2. Minimum Thickness of Mortar or Grout Between Masonry Units and Reinforcement: 1/4”.
3. Minimum Width of Collar Joints Containing Both Horizontal and Vertical Reinforcement: 1/2” larger than sum of diameters of horizontal and vertical reinforcement.
4. Splice reinforcement or attach reinforcement to dowels by placing in contact and wiring.
5. Shape and Dimension Reinforcement as Shown on Drawings.

a. Cold bend all bars.
b. Do not straighten or repair in manner that will injure material.
c. Do not use bars with kinks or bends not shown on Drawings.

6. The thickness of the grout between masonry units and reinforcing shall be a minimum of 1/2". Cut or trim face shells or cross webs as necessary to provide this clearance.
7. Place horizontal reinforcement only in bond beam units.
8. Erect vertical reinforcement in one piece, without splices, except where splices are specifically indicated.

E. Provide bond beam at shelf angle locations and as indicated.

3.4 GROUTING

A. Either high lift grouting or low lift grouting may be used.
B. Low Lift Grout System: Comply with CCR Title 24, Sec. 2104.6.

1. This system included placing reinforcing steel before or during construction of wall, and pouring grout in lifts not exceeding 2', unless cleanouts are provided as specified under High Lift Grout System.
2. Keep mortar out of grout spaces.
3. Place reinforcing steel accurately according to drawings and notes. Erect vertical reinforcing before laying masonry and brace firmly in position. Use frames or other suitable devices to prevent movement or jarring while placing masonry or grout. Place horizontal steel as construction progresses. Lap steel at least 48 bar diameters. Extend steel through points of stoppage to provide required lap. Horizontal steel may be wired temporarily above required position and tagged to indicate its location and vertically marked indicators maintained showing required location of horizontal bars.
4. After completion of grouting if doubt exists whether or not steel has been properly placed, use drill to locate steel, or open masonry as required by University's Representative. Make repairs as directed.
5. Install anchor bolts with the tail of bolt hooked over a continuous horizontal bar or an added #4 horizontal bar. Dry pack around void where anchor bolt penetrates masonry face shell.
6. Fill masonry cores with grout and immediately consolidate each cell with a mechanical vibrator having a 3/4" head and operating at 5000 RPM submerged.
7. Pour grout to 1-1/2" below top of masonry unit except at finish course. Immediately remove grout or mortar on exposed faces.
8. Form construction joints by stopping grout 1-1/2" below top of wall. If construction is to be stopped for more than 1 hour, form construction joint with top surface of CMU free of mortar or grout.
9. At jambs use temporary wood dams where necessary to contain mortar and grout

C. High Lift Grout System: Construct high lift concrete masonry in accordance with CCR Title 24, Sec. 2104.6, and OSA IR 24-4, Rev. 9/89, and with the following requirements:

1. Provide cleanout openings for cells at the bottom of each pour. Make the openings before the start of laying, of sufficient size and location to allow flushing away mortar droppings and debris. Cleanout openings may be cut in the CMU or formed in the foundation.
2. After the laying of masonry units is completed, the cells cleaned, the reinforcing positioned, and inspection completed, close the cleanouts by inserting face shells of masonry units or covering the opening with forms. Face shell plugs shall have a 2 day minimum curing time and shall be adequately braced to resist the pressure of the fluid grout.
3. Accurately place reinforcing steel inserts and bolts in accordance with the Contract Drawings. Hold both horizontal and vertical reinforcing in position by wire ties or spacing devices near

ends and at intervals not exceeding 160 diameters of the reinforcement.

4. Place the horizontal reinforcing as the construction progresses. Thread the vertical reinforcing into position after the completion of laying if adequate positioning devices and clearances are provided to permit such placement. Otherwise, erect vertical reinforcement ahead of masonry work.
5. Use bond beam units to facilitate the horizontal flow of grout and at all horizontal bars to provide a minimum opening at cross webs 1-1/2" high for the width of the cell.
6. Fill head and bed joints solidly with mortar. Take care in placing the mortar to keep a minimum of droppings from falling into the cells.
7. When adequate cross webs between face shells are not provided, install ties of heavy gage wire (number 9 or heavier, galvanized) embedded in the horizontal mortar joints across continuous vertical joints or between face shells to prevent "blowouts" from hydrostatic pressure of the fluid grout. External ties or braces may also be used for this purpose.
8. Brace ungrouted walls against wind and other lateral forces during construction.
9. Remove mortar droppings and overhangs from the foundation or bearing surface, cell walls, and reinforcing. Acceptable methods are as follows:

    a. Hosing with a high pressure jet stream at least twice a day (at midday and quitting time).
    b. Providing a 1 to 2" blanket of dry sand over the exposed surface of the foundation, dislodging hardened mortar from the cell walls and reinforcing using a pole or rod, and removing the mortar debris with the same high pressure jet stream.

10. In the high lift grouting method, intermediate horizontal construction joints are not permitted. Plan construction for one continuous pour of grout to the top of the high lift portion of the wall in 4' layers or lifts in the same working day. Should a blowout, a breakdown in equipment, or any other emergency occur, cease the grouting operation. Use procedures acceptable to the University's Representative.
11. To prevent "blowouts" do not pour grout until the mortar has set and cured. However, grout the walls as soon as possible thereafter to reduce shrinkage cracking of the vertical joints. Cleanout closures, reinforcing, bolts and embedded connection items shall be in position before grouting is started. All cells shall be filled with grout.
12. Handle grout from the mixer to the point of deposit in the grout space as rapidly as practicable by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry unit surfaces not being immediately encased in the grout lift. Depending upon weather condition and absorption rates of the masonry units, the lift heights and waiting periods may be varied. Under normal weather conditions, with typical masonry units, limit the individual lifts of grout to 4' in height with a waiting period between lifts of 30 to 60 minutes.
13. Place the first lift of grout to a uniform height within the pour section and vibrate thoroughly to fill all voids. This first vibration shall follow the pouring of the grout by not more than 10'. Vibrate or consolidate with approved mechanical vibrators.
14. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, pour succeeding lift and vibrate alternate cells by extending vibrator 12" to 18" into the preceding lift to reconsolidate the preceding lift and close plastic shrinkage cracks or separations from the cell walls.
15. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding lift, reconsolidate each lift by reworking with the vibrator as soon as the grout has taken its settlement shrinkage.
16. Repeat the waiting, pouring and reconsolidating steps until the top of the pour is reached. Also

reconsolidate the top lift after the required waiting period and fill space left by settlement shrinkage with grout.

3.5 CLEANING

A. Cut out defective joints and holes in exposed masonry and repoint with mortar.

B. Dry brush masonry surface after mortar has set, at end of each day's work and after final pointing.

C. Leave work and surrounding surfaces clean and free of mortar spots and droppings.

D. Cleaning Brick Masonry:

1. Apply cleaning agent to sample wall area in location acceptable to the University's Representative.
2. Do not proceed with cleaning until sample area is accepted by the University's Representative.
3. Clean initially with stiff brushes and water.
4. When cleaning agent is required, go through TSP-detergent routine before using commercial cleaners.

    a. Follow brick manufacturer's recommendations.
    b. Thoroughly wet surface of masonry on which no green efflorescence appears.
    c. Scrub with acceptable cleaning agent.
    d. Immediately rinse with clear water.
    e. Do small sections at a time.
    f. Work from top to bottom.
    g. Protect all sash, metal lintels, and other corrodible parts when masonry is cleaned.

3.6 PROTECTION OF WORK

A. Protect sills, ledges, and offsets from mortar drippings or other damage during construction.

B. Remove misplaced mortar or grout immediately.

C. Cover top of walls with strong non-staining waterproof coverings at end of each day or shut down.

D. Extend protective covering at least 2' down each side of wall and securely anchor.

1. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover at least 2' down face next to unconstructed wythe and hold cover in place.

E. Protect face materials against staining.

3.7 FIELD QUALITY CONTROL

A. Field Tests for Strength of Mortar and Grout: The strengths specified for grout and mortar shall be verified during the process of the Work by testing samples taken at the Project Site as follows:

1. Mortar: Take at least 3 specimens each day of mortar placed that day. Spread a layer of mortar 1/2" to 5/8" thick on the masonry units and allow to stand for one minute. Remove the mortar and place it in a 2" by 4" cylinder in 2 layers, compressing the mortar into the cylinder using a

flat end stick or fingers. Lightly tap the mold on opposite sides, level off and immediately cover molds and keep them damp until taken to the laboratory. After 48 hours, remove molds and place specimens in a fog room until tested in the damp condition. Samples shall be tested in accordance with the applicable portions of ASTM C 39.

2. Grout: Take at least 3 specimens each day of grout placed that day. On a flat nonabsorbent base, form a space approximately 3" by 3" by 6" using masonry units having the same moisture condition as those being laid. Line the space with a permeable paper or porous separator so that water may pass through the liner into the masonry units. Thoroughly mix or agitate grout to obtain a fully representative mix and place into molds in 2 layers. Puddle each layer with a 1" by 2" puddling stick to eliminate air bubbles. Level off and immediately cover molds and keep them damp until taken to the laboratory. After 48 hours, remove molds and place specimens in a fog room until tested in the damp condition. Samples shall be tested in accordance with the applicable portions of ASTM C 39.
3. Continuous Inspection: Contractor's Independent Testing/Inspection Laboratory shall perform continuous inspection of the structural reinforced masonry. The inspector shall be certified as a qualified masonry inspector by the ICBO and DSA. The masonry inspector shall be at the project Site during all masonry construction and perform the following duties:

    a. Review Drawings and Specifications and meet with the Contractor to discuss requirements before masonry construction activities commence.
    b. Check brand and type of cement, lime (if used) and source of sand.
    c. Inspect the foundation to ascertain that it is clean and ready to receive units.
    d. Check reinforcing steel dowels for straightness, proper alignment, spacing, size and length.
    e. Observe proportioning of mortar, visually check aggregate to determine uniformity of grading, cleanliness and moisture.
    f. Observe manner in which units are laid up to insure that joints are full of mortar and kept tight. Inspect grout cells to assure that fins will not interfere with grouting. Instruct masons to keep grout cells clean of mortar droppings and inspect to determine compliance.
    g. Observe placing of grout continuously.
    h. Perform or supervise performance of required sampling and testing.
    i. Keep complete record of inspection of construction. Report weekly to the University's Representative the progress of the masonry inspection.

END OF SECTION 04 02000

SECTION 04 2613 - MASONRY VENEER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Clay face brick.
2. Mortar.
3. Ties and anchors.
4. Embedded flashing.
5. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in masonry veneer.
2. Steel shelf angles for supporting masonry veneer.

C. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups"
2. Section 03 3000 "Cast-in-Place Concrete" for [installing] dovetail slots for masonry-veneer anchors.
3. Section 05 1200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
4. Section 07 6200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Weeps.
3. Accessories embedded in masonry.

1.5 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.

C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Provide the following upon request:

1. Material Certificates: For each type and size of the following:
   a. Masonry units.
      1) Include .
      2) For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.

3) For exposed brick, include test report for efflorescence according to ASTM C 67.

b. Cementitious materials. Include name of manufacturer, brand name, and type.

c. Mortar admixtures.

d. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

e. Anchors, ties, and metal accessories.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.

2. Build mockups for typical exterior wall in sizes approximately 96 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.

a. Include a sealant-filled joint at least 16 inches long in mockup.

b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.

c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).

d. Include metal studs, sheathing, water-resistive barrier sheathing joint-and-penetration treatment air barrier, veneer anchors, flashing, cavity drainage material, and weeps in exterior masonry-veneer wall mockup.

3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.

4. Protect accepted mockups from the elements with weather-resistant membrane.

5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.

b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

7. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

2.3 BRICK

A. Regional Materials: Brick shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.

3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Clay Face Brick: Facing brick complying with ASTM C 216.

1. UCR Standard Brick: 3-1/2x2-3/16x11-1/2 inches.

2. Grade: SW.
3. Type: FBX.
4. Additional Requirements:
   a. Under no circumstances may the saturation coefficient requirements of ASTM C216, Table 1 Physical Requirements be waived.
   b. The minimum compressive strength of an individual brick shall be 34.5 MPa (5000 psi).
   c. Brick shall pass the freezing and thawing test as described in ASTM C67.
   d. Brick shall pass the efflorescence test as "not effloresced" as described in ASTM C67.
5. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi.
6. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C 67.
7. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
8. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
9. Application: Use where brick is exposed unless otherwise indicated.
10. Color and Texture: Match Architect's samples.

2.4 MORTAR MATERIALS

A. Regional Materials: Aggregate for mortar, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

F. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.

C. [BT-1] Adjustable Anchors for Connecting to Concrete, CMU, or Cold Formed Metal Framing Locations that are installed in a Seismic Racking Condition: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Backplate formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
    a. Basis of Design Products:
        1) BL-407 Backplate, with Wedge-Lok insulation washer, by Hohmann & Barnard, Inc.
        2) #2407 Backplate, by WireBond, Inc.
2. Tie Section: Box-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire.
    a. Basis of Design Products:
        1) Byna-Lok Seismic Wire Tie with continuous 3/16" wire by Homann & Barnard, Inc.
        2) #1500 Tie with welded clip and continuous 3/16" wire by WireBond, Inc.

D. [BT-2] Adjustable Masonry-Veneer Anchors (used where backup wall is a seismic drift condition):

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.105-inch- thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Fabricate wire connector sections from 0.187-inch- diameter, hot-dip galvanized, carbon -steel wire.
5. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
    a. Seismic Masonry-Veneer Anchors: Basis of Design Products:
        1) Hohmann & Barnard, Inc.; Seismiclip Anchor and Tie "2-Seal Thermal Wing Nut Anchor" with continuous 3/16" wire, galvanized.

2) WireBond, Inc.; Sure Tie WS with seismic clip and continuous 3/16" wire, galvanized.

E. Concealed Lintel System:

1. Hohmann & Barnard, Inc.: Surface Mounted. Double Side Rowlock.

2.6 EMBEDDED FLASHING MATERIALS

A. Masonry flashing shall be metal, except as otherwise noted. Metal flashing shall be through-wall, where feasible, except where otherwise clearly shown or noted. Through-wall flashing shall be 2-piece, except where otherwise clearly shown or noted.

B. Metal Flashing: Provide metal flashing complying with Section 07 6200 "Sheet Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel.
4. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
4. Where flashing is fully concealed, use metal flashing.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 6200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with phosphoric acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neopreneurethane or PVC.

B. Weep Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        1) Hohmann & Barnard, Inc.; QV Quadro-Vent.
        2) Wire-Bond; Cell Vent.
2. Mesh Weep: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following:
    a. Heckmann Building Products Inc.; Weep-Thru Mortar Deflector.
    b. Hohmann & Barnard, Inc.; Mortar Trap.
    c. Mortar Net USA, Ltd.; Mortar Net.
    d. Wire-Bond; Cavity Net DT
2. Configuration: Provide one of the following:
    a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
    b. Strips, not less than 3/4 inch thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weeps from clogging with mortar.
    c. Sheets or strips, full depth of cavity and installed to full height of cavity.
    d. Sheets or strips not less than 3/4 inch thick and installed to full height of cavity with additional strips 4 inches high at weeps and thick enough to fill entire depth of cavity and prevent weeps from clogging with mortar.

2.8 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.9 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Use Type N above grade and Type S below grade.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.

B. Provide not less than 1 inch of airspace between back of masonry veneer and face of sheathing insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints as follows:

1. Form open joint full depth of brick wythe and of width indicated, but not less than 1/2 inch for installation of sealant and backer rod specified in Section 07 9200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 9200 "Joint Sealants," but not less than 1/2 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING AND WEEPS

A. General: Install embedded flashing and weeps in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.

C. Install weeps in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep products open-head joints to form weeps.
2. Space weeps 24 inches o.c. unless otherwise indicated.
3. Cover cavity side of weeps with plastic insect screening at cavities insulated with loose-fill insulation.

D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Testing Prior to Construction: One set of tests.

D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weeps, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 1200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. All work under this section is subject to the Contract Documents, and Contractor shall be responsible for and governed by all requirements thereunder.

B. Inspections shall be in accordance with the Testing, Inspection.

C. Furnish all material, labor, equipment and supervision necessary to fabricate, receive, unload, store and erect structural steel.

D. Furnish all erection materials, labor, equipment and supervision necessary to receive, unload, store and "erect only" metal decking.

E. The work includes, but is not limited to, that which is indicated on structural and architectural drawings:

1. Beams and columns.
2. Miscellaneous angles and connection clip angles, plates, angle frames.
3. Stud type shear connectors.
4. Expansion anchors for erection and installation of structural members.
5. Structural steel items embedded in concrete.
6. Anchor rods with rigid templates for structural steel with proper orientation clearly marked on templates.

F. Work not included in this section:

1. Anchors, bolts or sleeves required for installation of equipment as shown on mechanical, plumbing and electrical drawings.
2. Metal clamps, anchors, ties or dowels for concrete work.
3. Setting of anchor rods or plates embedded in concrete.
4. Miscellaneous Metal – Section 05 50 10.

G. Carefully review and comply with all applicable general notes and typical details on Structural Drawings.

H. Where new construction adjoins existing facility, Contractor shall verify existing finish floor slab and finish roof elevations, and the top of steel elevation of structural members where existing and new construction meet. Any variation from drawings shall be reported immediately to the Structural Engineer of Record prior to submittals and fabrication and placing of structural work.

I. References

1. AISC: American Institute of Steel Construction Specification AISC 360.
2. ASTM: American Society for Testing and Materials.
3. AWS: American Welding Society Specification D1.1 and D1.8.

4. SDI: Steel Deck Institute Design Manual for Floor Decks and Roof Decks.
5. OSHA: Occupational Safety and Health Administration, Part 1926, Subpart R – Steel Erection.
6. AISC: Seismic Provisions, AISC 341 with Supplement No. 1.

J. Quality Assurance

1. Structural steel design, fabrication and erection shall be in conformance with AISC 360 "Specification for Structural Steel Buildings."
2. Shop and field welding shall be in accordance with AWS D1.1, Structural Welding Code - Steel.
3. Field welding shall be by certified welders qualified by tests prescribed in AWS D1.1 Structural Welding Code - Steel.
4. Field welding of light gauge steel members shall be by certified welders qualified by tests prescribed in AWS D1.3 Structural Welding Code - Sheet Steel.
5. Provide a Welding Procedure Specification (WPS) for each combination of weld variables, in accordance with AWS D1.1 requirements. Submit WPS's for procedures that are not prequalified to the Structural Engineer of Record for review and approval. Make all WPS's available to the Inspector of Record at the time of welding.
6. Metal decking shall be handled and erected in accordance with Steel Deck Institute Design Specifications.
7. Galvanized metal shall be prepared, coated, handled, stored and erected in accordance with ASTM A123.

1.2 SUBMITTALS

A. Prepare complete shop drawings including dimensioned erection plans for all members.

1. Clearly identify on shop drawings by "clouding" all shop and erection details, dimensions and member sizes which are different from the Structural Drawings.
2. Indicate all shop and erection details, showing dimensions, clearances, cuts, copes, connections, holes, threaded fasteners and welds.
3. All drawings shall be in accordance with AISC Specifications.
4. Shop drawings shall be complete, include field verification, and checked for accuracy and completeness by the fabricator prior to submission for review. Shop drawings which have not been checked by the fabricator will not be reviewed.
5. Shop drawing sheet size of 8 ½ x 11 and 11 x 17 are not allowed.

B. Submit 2 prints of each drawing and 5 copies of material brochures, catalog cuts and technical data to Structural Engineer of Record for approval.

C. Upon approval, distribute required copies as directed by General Contractor and evidence such distribution by copy of each transmittal to General Contractor.

D. Furnish anchor rod and embedded plate placing plans for structural steel.

E. Submit Welding Procedure Specifications for shop and field welds per AWS D1.1 for review and approval by the Structural Engineer of Record. Include electrode manufacturer's literature including certificate of conformance for all electrodes.

F. Charpy-V-Notch (CVN) Impact Test: Submit certified copies of Charpy-V-Notch (CVN) Impact Test by the manufacturer for applicable steel members and components.

1. Charpy-V-Notch (CVN) Impact Test for Base Metal: Braced Frame columns, and girders subjected to Charpy-V-Notch impact test in accordance with "Seismic Provisions for Structural Steel Buildings", Part I, Section 6.3, as modified by Supplement1.
2. Exception: Rolled shapes with a flange thickness exceeding 2 inches shall have the cahrpy-v-notch test, as specified above, performed on flange material at the juncture of the web and flange per AISC 13th Edition, Section A3.1c.
3. Charpy-V-Notch test shall be performed by the manufacturer employing Test Frequency (P) in accordance with ASTM A 673 and utilizing standard specimen sizes shown in Figure 6 of ASTM E 23. The absorbed energy in a CVN impact test shall not be less than that specified in Material Part 2 of this section.

G. Submit certified copies of tests by manufacturer for fine grain practice. Structural steel base material, as described above, shall be manufactured using fully killed fine grain practice having grain size number 5 or better as determined by ASTM E 112.

H. Manufacturer's Mill Certificate:

1. Submit, certifying that products meet or exceed specified requirements.

I. Mill Test Reports:

1. Submit manufacturer's certificates, indicating structural yield and tensile strength, destructive and non-destructive test analysis.

J. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation from the manufacturer indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit MR 5: For products having regional materials, documentation from the manufacturer indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Product Data for Credit IEQ 4.1: For all adhesives and sealants applied on site and inside the weatherproofing barrier, documentation from the manufacturer indicating VOC content (g/L) in compliance with South Coast Air Quality Management District Rule #1168 2005. For aerosol adhesives, documentation from the manufacturer indicating VOC content (% VOCs by weight) in compliance with the Green Seal Standard for Commercial Adhesives GS-36 2000.
4. Product Data for Credit IEQ 4.2: For all paints and coatings applied on site and inside the weatherproofing barrier, documentation from the manufacturer indicating VOC content (g/L) in compliance with the following:

a. For anti-corrosive and anti-rust paints applied to interior ferrous metal materials, comply with Green Seal Standard GS-03 1997.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel W and WT Shapes: ASTM A992.

B. Hollow Structural Sections (HSS): ASTM A500 Grade B.

C. Pipe: ASTM A53.

D. Structural Steel Angles, Channels, Plates and Bars: ASTM A36, uno.

E. Bolts - Structural Connections: ASTM A325 or F1852.

F. Anchor Rods: ASTM F1554.

G. Welding Electrodes

1. For Structural Steel Connections: E70XX.
2. For Welding Of Metal Deck: E70XX.
3. For full penetration welds, resulting welds shall have a Charpy v-notch toughness of not less than 20 ft lbs at -20°F and 40 ft lb at 70°F.

H. Stud Type Shear Connectors

1. ASTM Al08 and AWS D1.1.
2. Acceptable Manufacturer: Nelson Stud or approved equal.

I. Expansion Anchors

1. Concrete: Wedge type anchor.

a. Kwik-Bolt TZ by Hilti Inc
b. Strong Bolt by Simpson, or approved equal.

2.2 DESIGN

A. Questions of interpretation of drawings or details shall be directed to the Structural Engineer of Record before submittal of bid.

2.3 FABRICATION

A. Connections shall be as shown on the drawings.

B. Holes

1. In general, holes shall be fabricated in the shop, and any additional holes that may be required in the field shall be drilled with approval of Structural Engineer of Record.
2. Provide holes in members to permit connection of the work of other trades.
3. Fabricator to furnish templates or such information as may be required for holes, slots, etc, required for any field fabrication.
4. Holes in base or bearing plates shall be punched or drilled.
5. Provide grout holes between column flanges in column base plates.
6. Do not make or enlarge holes by burning.
7. General Contractor to provide templates or such information as may be required for holes in miscellaneous steel hangers for moveable partitions and suspended equipment.

C. Column Bases and Plates

1. Conform to AISC Specification unless otherwise indicated on drawings or authorized by the Structural Engineer of Record.
2. Weld all base plates and cap plates as shown on the drawings.

D. Straightness and camber of structural members shall conform to AISC Specification unless otherwise noted on the drawings or authorized by the Structural Engineer of Record.

E. Furnish anchor rods for all structural steel with templates for placing in concrete work.

F. Surface Preparation and Priming

As per Section 05 05 13.
1. Galvanize steel fabrications as per 05 05 12.

PART 3 - EXECUTION

3.1 ERECTION OF STEEL

A. The method and sequence of erection is the responsibility of Contractor.

1. Temporary bracing, guying and temporary connections required during erection shall be the responsibility of Contractor, designed by qualified persons for safety in conformance with local, state and federal codes, and AISC Specifications. Do not depend on anchor rods for temporary bracing or guying.
2. These temporary supports shall secure the steel framing, or any partly assembled steel framing, against loads comparable in intensity to those for which the structure was designed, resulting from wind, seismic forces and erection operations, but not the loads resulting from the performance of work by or the acts of other contractors.
3. Plumbing-up equipment is required to be used and kept in place as deemed necessary by the erecting contractor.
4. Maintain the work in a safe and stable condition during all stages of erection.
5. All erection work shall be under the supervision of a qualified and competent superintendent experienced in this type of work.
6. Contractor shall determine if two bolts are adequate to ensure stability of cantilevered members. Contractor shall install additional bolts, if necessary.

7. Steel erection shall be in accordance with OSHA Regulations, Part 1926, Subpart R – Steel Erection.

B. Drift pins may be used only to bring together the several parts. Do not use in the use of such manner gas cutting as to destroy or damage the metal.

C. The use of gas cutting torch in the field for correction of fabrication errors will not be permitted, unless approved by the Structural Engineer of Record.

D. Field connections: A325, F1852 bolts or field welded.

1. Unless otherwise indicated on the drawings, use A325 high strength bolts. Bearing type with threads permitted in shear planes.
2. Except for slip-critical bolts, no combination of welding and bolts shall be used in the same face of any connection.
3. Welded connections: permitted only as indicated on the drawings or as specifically authorized by the Structural Engineer of Record

E. Bolted Connections

1. High strength bolts in bracing connections, moment connections, column splices, drag connections, and other "special" connections indicated on the Drawings shall be installed using tension control bolts (F1852) or bolts with direct tension indicators in compliance with current Specifications for Structural Joints Using ASTM A325 or A490 Bolts, as approved by the Research Council on Riveted and Bolted Structural Joints and endorsed by AISC.
2. Bolts in all other connections may be installed in a "snug- tight" condition to insure all surfaces of joint materials are brought into good contact with each other. Snug-tightness is defined as the tightness created by a few impacts of an air wrench or the full effort of a worker using an ordinary spud wrench.

F. Contractor shall support column base plates on grout pads, leveling nuts or shim packs adequate to transfer the construction loads, prior to final grouting.

1. At Contractor's option, leveling plates set in a full bed of nonshrink grout prior to erecting columns, may be used with proper orientation clearly marked.

G. Stud-type Shear Connectors

1. Field apply to steel beams for composite construction.
2. Size and number of studs shall be as shown on drawings.
3. Installed shear studs shall fully develop manufacturer's published shear rating.
4. Inspection of Studs

a. Shear studs shall be visually inspected for full weld fusion all around.
b. Studs with incomplete welding shall be tested by bending
c. the stud 15° toward the nearest end of the beam with a hammer or pipe.
d. A minimum of two studs or 5% of studs on each girder shall be tested. A minimum of one stud or 10% of studs on each beam shall be tested.
e. Studs broken off shall be replaced, and the new studs tested.

f. If two or more failures occur on the same beam or girder, all studs on that member shall be tested.

3.2 ERECTION OF METAL DECKING

A. Composite Deck Floor Construction

1. Place deck with corrugations perpendicular to supports, side lapped not less than one corrugation, and end laps always over a supporting member.
2. Attach sheets to supports both perpendicular and parallel to span of deck as recommended by manufacturer but not less than12" oc. Attachment of deck shall be in accordance with required Underwriters' Laboratories assembly.
3. Install pour stop angle as indicated on drawings including all required accessories bolts, nuts, etc.

B. Metal Roof Deck

1. Anchor with 5/8" diameter puddle welds directly through bottom of rib to all structural supports, including supports parallel to spans of deck. See drawing for welding pattern.
2. Secure side laps with per details on drawings.

C. Place metal decking in accordance with approved erection drawings and with proper end and side laps in conformance with local, state and federal codes.

D. Steel erection shall be in accordance with OSHA Regulations, Part1926, Subpart R – Steel Erection.

END OF SECTION 05 1200

SECTION 05 3100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof deck.
2. Noncomposite form deck.

B. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For steel deck.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Nucor Corp.; Vulcraft Group.
3. Verco Manufacturing Co.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: Simple span.
6. Side Laps: Interlocking seam.

2.3 NONCOMPOSITE FORM DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Nucor Corp.; Vulcraft Group.
3. Verco Manufacturing Co.
4. Or approved equal.

B. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Profile Depth: 1-1/2 inches .
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: Simple span.
5. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi , not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi , of same material and finish as deck, and of thickness and profile indicated or as recommended by SDI Publication No. 31 for overhang and slab depth.

F. Galvanizing Repair Paint: ASTM A 780 or SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members with screws as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals indicated and as follows:

1. Mechanically clinch or button punch.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches , with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members with screws as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals indicated and as follows:

1. Mechanically clinch or button punch.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:

1. End Joints: Lapped.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: The University will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to the Design Build team and the University Representative.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Design Builder's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 4000 - COLD-FORMED METAL FRAMING

1. GENERAL

1.1 SUMMARY

A. Section Includes

1. Exterior non-load-bearing wall framing

B. Related Sections

1. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing
2. Division 09 Section "Gypsum Board" for conventional suspended gypsum ceiling framing

1.2 REFERENCES

A. AISI – American Iron and Steel Institute

1. S100 – Design of Cold-Formed Steel Structural Members
2. S200 – Cold-Formed Steel Framing–General Provisions

B. ASTM International

1. A 36 – Carbon Structural Steel
2. A 123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. A 153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4. A 653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
5. A 780 – Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
6. A 1003 – Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
7. C 1107 – Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
8. C 1513 – Steel Tapping Screws for Cold-Formed Steel Framing Connections
9. E 119 – Fire Tests of Building Construction and Material
10. E 488 – Strength of Anchors in Concrete and Masonry Elements
11. E 1190 – Strength of Power-Actuated Fasteners Installed in Structural Members
12. F 1554 – Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

C. AWS – American Welding Society

1. D1.1 – Structural Welding Code—Steel
2. D1.3 – Structural Welding Code - Sheet Steel

D. MIL – Military Specifications, United States Department of Defense

1. P-21035 – Paint High Zinc Dust Content, Galvanizing Repair

E. SSMA – Steel Stud Manufacturers Association

1. Product Technical Information

F. SSPC – The Society for Protective Coatings

1. Paint 20 – Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As follows

a. Dead Loads: As shown on the structural drawings.
b. Live Loads: As shown on the structural drawings.
c. Wind Loads: As per the criteria provided in the structural drawings.
d. Seismic Loads: As per the criteria provided in the structural drawings.

2. Deflection Limits: Design framing systems to withstand the design loads without deflections greater than the following:

a. Exterior Non-Load-Bearing Framing: Horizontal deflection limit as follows –

Walls with flexible finish (metal panel): L/120.
Walls with brittle finish (glass): L/240
Walls with stucco/plaster: L/360.
Walls with brick finish: L/600

b. Ceiling Joist Framing: Vertical deflection of L/360 of the span.

3. Deflection Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

a. Downward movement of 1/2 in.

1.4 SUBMITTALS

A. Sustainable Design Submittals: For products having recycled content, document percentages by weight of postconsumer and preconsumer recycled content.

1. Include statement indicating costs for each product having recycled content.

B. Product Data: For each type of cold-formed metal framing product and accessory indicated.

C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the California Registered Professional Engineer responsible for their preparation.

D. Welding certificates.

E. Research/Evaluation Report: For cold-formed metal framing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

2. PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. Current SSMA Members (ICC-ES Report ESR-3064P)
2. California Expanded Metal Products Company.
3. Clark Steel Framing.
4. Dale/Incor.
5. Dietrich Metal Framing; a Worthington Industries Company.
6. MarinoWare; a division of Ware Industries.
7. United Metal Products, Inc.
8. Or equal, as approved in accordance with Division 01 requirements for Substitutions

2.2 REGULATORY REQUIREMENTS

A. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

B. Comply with AISI S100 and S200

2.3 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST33H (ST230H)
2. Coating: G90 or equal.

C. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50 (340), Class 1 or 2
2. Coating: G90 (Z275)

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm)
2. Flange Width: 1-5/8 inches (41 mm)

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs
2. Flange Width: 1-1/4 inches (32 mm)

C. Steel Headers: ProX Header, by Brady Construction Innovations Inc, or approved equal

D. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Dietrich Metal Framing; a Worthington Industries Company
b. MarinoWare, a division of Ware Industries
c. SCAFCO Corporation
d. The Steel Network, Inc.
e. Or equal, as approved in accordance with Division 01 requirements for Substitutions

E. Single Deflection Track for use in fire-rated assemblies: As specified in Section 07 84 00

F. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm)
b. Flange Width: As noted on drawings.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm)
b. Flange Width: Outer deflection track flange width plus 1 inch (25 mm)

G. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing
2. Bracing, bridging, and solid blocking
3. Web stiffeners
4. Anchor clips
5. End clips
6. Foundation clips
7. Gusset plates
8. Stud kickers, knee braces, and girts
9. Joist hangers and end closures
10. Hole reinforcing plates
11. Backer plates

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked bolts, carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere

F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035, ASTM A 780 Annex 2

B. Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members

2.8 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, SSMA publications, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: pace individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

3. EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07, in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches unless indicated otherwise

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Connect vertical deflection clips to studs and anchor to building structure.
2. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: The University will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to the Design Build team and the University Representative.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Design Builder's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for operable partitions.
3. Steel framing and supports for overhead doors.
4. Steel framing and supports for countertops.
5. Steel tube reinforcement for low partitions.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel framing and supports for applications where framing and supports are not specified in other Sections.
8. Elevator machine beams, hoist beams, and divider beams.
9. Steel shapes for supporting elevator door sills.
10. Shelf angles.
11. Metal ladders.
12. Metal pipe crossovers.
13. Miscellaneous steel trim including loading-dock edge angles.
14. Fiberglass Gratings.
15. Metal bollards.
16. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups"
2. Section 03 3000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
3. Section 05 1200 "Structural Steel Framing."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Prefabricated building columns.
3. Metal nosings and treads.
4. Paint products.
5. Grout.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4.2: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

E. Samples for Verification: For each type and finish of extruded nosing.

F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

C. Provide the following upon request:

1. Qualification Data: For professional engineer.
2. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
3. Welding certificates.
4. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
5. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design products indicated, including, but limited to:

1. Ladders.
2. Slotted channel framing.

B. ~~Structural Performance of Aluminum Ladders: Aluminum ladders~~, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 316L.

E. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L.

F. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: As indicated.

2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.

~~I. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.~~

~~J. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.~~

~~K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.~~

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.

2. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Eyebolts: ASTM A 489.

G. Machine Screws: ASME B18.6.3.

H. Lag Screws: ASME B18.2.1.

I. Plain Washers: Round, ASME B18.22.1.

J. Lock Washers: Helical, spring type, ASME B18.21.1.

K. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

L. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

M. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

N. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 FIBERGLASS GRATINGS

A. Fiberglass reinforced composite of polyester or vinyl ester resin with a molded-in integral grit surface. Manufactured in a one piece construction process by interlacing pre-wetted glass reinforcing strands in a liquid resin matrix within a given configuration. Once the resin has cured, the molded grid is removed from the mold.

1. McNICHOLSSquare Mesh Molded Fiberglass Grating or equal.
2. Size: 1 ½”x1 ½” .
3. Provide galvanized steel frame as indicated.

2.8 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.9 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch- diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.

7. Galvanize and prime ladders, including brackets.

2.10 METAL PIPE CROSSOVERS

~~A.~~ Provide metal pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.`

~~a. O'Keefes: 522 Ship Ladder~~

~~2. Treads shall be not less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height shall be not more than 9-1/2 inches.~~

3. ~~Fabricate~~ pipe crossovers, including railings from aluminum.

~~4.~~ ~~Fabricate treads~~ and platforms from pressure-locked aluminum bar gratingor extruded-aluminum plank grating. Limit openings in gratings to no more than [1/2 inch] [3/4 inch] in least dimension.~~Comply with applicable railing requirements in Section 05 5213 "Pipe and Tube Railings."~~

2.11 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime miscellaneous steel trim.

2.12 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.

B. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.

D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.

E. Prime bollards with zinc-rich primer.

2.13 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

2.14 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.15 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.16 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

C. Exterior Steel Finish: Galvanized and primed.

2.17 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Hot-dip galvanize steel fabrications exposed to weather.

2. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean materials of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3. Items Indicated to Receive Primers Specified in Section 09 9600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.18 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions and overhead doorssecurely to, and rigidly brace from, building structure.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least 4 inches in concrete.

C. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.

D. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.

E. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.4 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

1. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 05 5113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled ~~precast concrete~~ and stone treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

B. Related Requirements:

1. Section 03 3000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Section 05 5213 "Pipe and Tube Railings" for pipe and tube railings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Laboratory Test Reports for Credit IEQ 4.2: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For stairs and railings indicated to comply with performance requirements, design criteria, and special loading, provide comprehensive engineering analysis signed and sealed by the qualified professional structural engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Accessibility: Comply with requirements of the 2010 ADA Standards and 2013 CBC 11B.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Provide the following upon request:

1. Welding certificates.

2. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design stairs and railings.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..

2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..

3. Uniform and concentrated loads need not be assumed to act concurrently.

4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
   b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Tubing: ASTM A 500 (cold formed), Grade B or ASTM A 513.

E. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.

F. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

G. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial steel, Type B, or structural steel, Grade 33, unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

F. Concrete Materials and Properties: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

~~2.5 PRECAST CONCRETE TREADS~~

~~A. Concrete Materials and Properties: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of~~ 5000 psi ~~and a total air content of not less than 4 percent or more than 6 percent.~~

~~B. Reinforcement: Galvanized, welded wire reinforcement,~~ 2 by 2 inches~~by~~ 0.062-inch- ~~diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.~~

~~C. See drawings for nosing details.~~

2.6 STONE TREADS

A. Stone Treads: As indicated on drawings.

1. See drawings for nosing details.

2.7 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Weld exposed corners and seams continuously unless otherwise indicated.

5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.8 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Commercial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel channels.
    a. Provide closures for exposed ends of channel stringers.
2. Construct platforms of steel channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

1. Steel Sheet: Uncoated cold -rolled steel sheet[unless otherwise indicated].
2. Steel Sheet: Galvanized-steel sheet, where indicated.
3. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.
4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
5. Shape metal pans to include nosing integral with riser.
6. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
7. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
    a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.9 STAIR RAILINGS

A. Comply with applicable requirements in Section 05 5213 "Pipe and Tube Railings."

1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
2. Connect posts to stair framing by direct welding unless otherwise indicated.

B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

2.10 FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Section 03 3000 "Cast-in-Place Concrete."

~~1.~~ Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

H. ~~Install precast concrete treads with adhesive supplied by manufacture~~r.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding to steel supporting members.

2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

2. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 05 5119 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes industrial-type, straight-run stairs with steel-grating treads and railings attached to metal grating stairs.

B. See Section 05 5313 for bar gratings used in catwalk connected to metal grating stairs.

1.3 COORDINATION

A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Laboratory Test Reports for Credit IEQ 4.2: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Shop Drawings: Include plans, elevations, sections, details, and attachments.

C. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Provide the following upon request:

1. Welding certificates.

2. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design stairs and railings.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..

2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..

3. Uniform and concentrated loads need not be assumed to act concurrently.

4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

5. Limit deflection of treads, platforms, and framing members to L/360.

C. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

E. Wire Rod for Grating Crossbars: ASTM A 510.

F. Cast-Abrasive Nosings: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be galvanized.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.

B. Form exposed work with accurate angles and surfaces and straight edges.

C. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.

D. Fabricate joints that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel channels.
   a. Provide closures for exposed ends of channel stringers.
2. Construct platforms of steel channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld stringers to headers; weld framing members to stringers and headers.

C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded or pressure-locked steel grating with 1-1/4-by-3/16-inch bearing bars at 15/16 inch o.c. and crossbars at 4 inches o.c.
2. Fabricate treads and platforms from welded or pressure-locked steel grating with openings in gratings no more than 1/2 inch in least dimension.
3. Surface: Plain.
4. Finish: Galvanized.
5. Fabricate grating treads with cast-abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
6. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.7 STAIR RAILINGS

A. Comply with applicable requirements in Section 05 5213 "Pipe and Tube Railings."

1. Fabricate newels of square steel tubing and provide newel caps of pressed steel, as shown.
2. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
3. Connect posts to stair framing by direct welding unless otherwise indicated.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel-stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
1. Use nonmetallic, nonshrink grout unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 05 5213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel tube railings.
2. Cable infill.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups"
2. Section 05 5112 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.
3. Section 05 5119 "Metal Grating Stairs".
4. Section 05 7300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

D. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4.2: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

E. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.

F. Delegated-Design Submittal: For railings, including comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Provide the following upon request:

1. Qualification Data: For testing agency.
2. Welding certificates.
3. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
4. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
5. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
6. Evaluation Reports: For post-installed anchors , from ICC-ES.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
   b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Wire Rope and Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Feeney, Inc.
   b. Johnson, C. Sherman, Co., Inc.
   c. Ronstan International Inc.
2. Wire Rope: 1-by-19 wire rope made from wire complying with ASTM A 492, Type 316.
3. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

2.4 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

3. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

G. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

J. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form Changes in Direction as Follows:

1. As detailed.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inchor less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

Q. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize indicated steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 05 5313 - BAR GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal bar gratings and metal frames and supports for gratings.

B. Interior catwalk.

C. Related Requirements:

1. Section 05 1200 "Structural Steel Framing" for structural-steel framing system components.
2. Section 05 51019 "Metal Grating Stairs" for grating treads and landings of steel-framed stairs.
3. Section 05 5213 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.3 COORDINATION

A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.
2. Paint products.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4.2: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Shop Drawings: Include plans, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For gratings, including comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

B. Provide the following upon request:

1. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.

2. Welding certificates.

3. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corporation, a Gibraltar Industries company.

2. Grating Pacific, Inc.

3. Harsco Industrial IKG, a division of Harsco Corporation.

4. Ohio Gratings, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design gratings.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.

2. Floors: Uniform load of 250 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.

3. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft..

4. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft..

5. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.

6. Limit deflection to L/360 or 1/4 inch, whichever is less.

C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

B. Welded Steel Grating: See Structural Drawings.

1. ~~Bearing Bar Spacing:~~ 7/16 or 1/2 inch ~~o.c.~~

2. ~~Bearing Bar Depth: As required to comply with structural performance requirements.~~

3. ~~Bearing Bar Thickness: 1/4 inch.~~

4. ~~Crossbar Spacing: 4 inches o.c.~~

5. ~~Traffic Surface: Plain.~~

6. ~~Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.~~

C. Pressure-Locked Steel Grating : Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.

1. Bearing Bar Spacing: 7/16 or 1/2 inch o.c.

2. Bearing Bar Depth: As required to comply with structural performance requirements.

3. Bearing Bar Thickness: 1/8 inch.

4. Crossbar Spacing: 4 inches o.c.

5. Traffic Surface: Plain.

6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

2.4 FERROUS METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating.

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563 and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

D. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.7 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.

2. Fabricate toeplates for attaching in the field.

3. Toeplate Height: 4 inches unless otherwise indicated.

G. Do not notch bearing bars at supports to maintain elevation.

2.8 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

B. Galvanize steel frames and supports in the following locations:

1. Interior.

2.9 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 05 70 10 - SITE METAL FABRICATIONS

PART 1 — GENERAL

1.1 SUMMARY

A. Section Includes:

1. Handrails.
2. Guardrails.
3. Threaded Rod and Nuts for Anchorage.

1.2 REFERENCES

A. UBC — Uniform Building Code, Current Edition.

B. ASTM — American Society for Testing and Materials:

1. A 194-01a — Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
2. A 276-00a — Specification for Stainless Steel Bars and Shapes.
3. C 881-99 — Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
4. F 593-98 — Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
5. F 594-98 — Specification for Stainless Steel Nuts.
6. A 554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
7. A 492 - Standard Specification for Stainless Steel Rope Wire.

C. AWS — American Welding Society, Inc.:

1. A2.4 — Standard Welding Symbols.
2. D1.6 — Structural Welding Code (Stainless Steel).

1.3 DEFINITIONS

A. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

B. Excessive Compaction: Planting area soil compaction greater than 75 percent maximum dry density as determined by ASTM D 1557.

1.4 SUBMITTALS

A. General Requirements: Refer to Division 1.

B. Product Data: Adhesive.

C. Shop Drawings:

1. Submit Shop Drawings of fabricated items for acceptance prior to fabrication including structural engineering with calculations for security fencing and concrete footings.

2. Show shop and erection details including dimensions, sizes, thicknesses, gauges, finishes, joining, attachments, holes, welds, bolts, elevations and relationship of work to adjoining construction, including finished soil grades and finished paving surfaces.

3. Where welded connectors, concrete, or masonry inserts are required to receive Work, show exact locations required.

4. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from Drawings.

5. Indicate welded connections using standard AWS A2.4 welding symbols.

6. Furnish accepted Shop Drawings to the trades responsible for installing the connectors or inserts.

D. Samples:

1. Handrail and Post Connections: Three 12-inch long pieces of rail, each welded to a 6-inch long piece of post.
2. Guardrails and Post Connections: Three 12-inch long pieces of rail, each welded to a 6-inch long piece of post.
3. Cables: Three 12 inch long pieces of cable with associated accessories.

E. Certificates: Welder's Certificates: Certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.5 QUALITY ASSURANCE

A. Contractor Qualifications: Workmanship shall be best standard practice of trades and shall be performed by mechanics skilled in type of Work required.

B. Regulatory Requirements: Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protective Pads: Use protective pads to prevent damage to galvanization and paint coatings when lifting, handling and shipping.

B. Handling: Provide adequate support and attachments during handling to prevent structural damage.

1.7 SITE CONDITIONS

A. Field Measurements: Secure field measurements required for adequate fabrication and installation of the Work covered by this Section.

1.8 WARRANTY

A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from the date of notice of Final Completion against defects in materials and workmanship.

B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship.

C. Exceptions: Contractor shall not be held responsible for failures due to ordinary wear, abuse or neglect by Others, vandalism and other causes outside the Contractor's control.

PART 2 — PRODUCTS

2.1 MATERIALS

A. Adhesive for Anchoring Steel in Concrete: ASTM C881, 2 component, chemical-resistant, structural epoxy bonding system designed for use in anchoring threaded rods, bolts, reinforcing bars, and smooth dowels into solid material.

B. Tube Steel for Handrail, Guardrail, Stair Handrail: ASTM A269, Type 304 stainless steel by 1 ½ inch OD.

C. Bar Steel for Handrail, Guardrail, Stair Handrail Post and Wall Mount: ASTM 276, Type 304 stainless steel.

D. Grout: ASTM C 1107, high-strength, non-shrink, waterproof.

E. Flat Washers: Type 304 stainless steel

2.2 SHOP FABRICATION

A. Accepted Shop Drawings: Do not fabricate or deliver metal fabrications to the site before Shop Drawings have been accepted.

B. Field Measurements: Verify measurements in field prior to fabrication.

C. Fabrication:

1. Fabricate items per accepted Shop Drawings.

2. Fabricate items accurately fitted free from distortion or defects.

3. Miter corners and angles of frames unless indicated otherwise.

D. Templates: Furnish templates for exact location of anchor bolts, and other items to be embedded in concrete, with setting instructions required for installation of embedded items.

E. Shop Welding:

1. Meet requirements of AWS D1.6 for stainless steel.

2. Grind visible welds smooth and finish so that joints are not visually detectable and rails appear as single pieces.

F. Galvanizing: Hot-dip galvanize.

2.3 MANUFACTURERS

A. Acceptable Manufacturer: AGS Stainless, Inc. - Cable Rail, which is located at: 7873 N. E. Day Rd.; Bainbridge Island, WA 98110; Toll Free Tel: 888-842-9492; Tel: 206-842-9492; Fax: 206-842-8179 ; Email:request info (info@agsstainless.com); Web:www.agsstainless.com. Or Equal.

PART 3— EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

B. Notification: Before proceeding with Work, notify the Owner's Representative in writing of unsuitable conditions.

C. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

A. Protection:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.

2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.

3. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.

4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.

5. Submit written notification of conditions damaged during construction to the Owner's Representative immediately.

B. Embedded Items: Supply metal items required to be cast into concrete or embedded in masonry with setting templates to appropriate trades.

3.3 INSTALLATION

A. Attachment:

1. Coordinate site metal fabrications with adjoining work for details of attachment, fittings, etc.

2. Do cutting, drilling, threading, tapping, etc., required for attachment of site metal fabrications to adjacent Work.

3. Install anchors, bolts, washers, inserts, lag screws, and other miscellaneous steel or iron fastenings required for installation, completion of Work, as indicated on Drawings, details and schedules, at time scheduled for Work.

B. Field Welding:

1. Meet requirements of AWS D1.6.

2. Welding will be permitted only where indicated or accepted on the Shop Drawings.

C. Exposed Moldings and Frames: Miter corners and angles of exposed moldings and frames unless otherwise noted.

D. Field Assembly:

1. Install items plumb and level, accurately fitted, free from distortion or defects.

2. Meet requirements of accepted Shop Drawings.

3. Brace and carefully handle shop fabricated items subject to damage to prevent distortions or other damage.

4. After assembly, align and adjust the various members forming parts of a completed frame or structure accurately before being fastened.

5. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

6. Obtain acceptance prior to site cutting or making adjustments not scheduled.

E. Fastening:

1. Provide miscellaneous fastenings necessary for the complete assembly and installation.

2. Install fasteners as specified.

F. Plates Anchored by Adhesive in Concrete:

1. Drill holes to diameter recommended by adhesive manufacturer.

2. Install adhesive in accordance with the adhesive manufacturer’s current printed instructions.

G. Cable Installation:

1. Install railing system plumb, level, and true and in accordance with manufacturer's installation instructions and recommendations.

2. Do not tighten the cables more than what is necessary to eliminate any sag.

3. Provide anchorage devices and fittings to secure to in-place construction to adjacent construction. Separate dissimilar materials with bushings, grommets or washers to prevent electrolytic corrosion.

4. Do not cut components, except for cable as required for installation, or abrade component finishes. Field touch-up of finishes only acceptable if done as per manufacturer's recommendations. Return components with damaged finishes to shop for required alterations according to manufacturer's return policy, followed by complete refinishing or provide new components.

5. Secure mounting brackets to building structure in a positive manner using manufacturer recommended reinforcement and anchorage methods for substrate conditions. Locate brackets and hardware at spacing required to support structural loads.

6. Installation of railing system shall be rigid and secure, installed by mechanics experienced in erection of architectural metal. Mounting hardware shall be drawn up tightly. Rails shall be set plumb and aligned.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/8-inch.

B. Maximum Offset from True Alignment: 1/16-inch.

C. Maximum Out-of-Position: 1/8-inch.

3.5 CLEANING

A. Finished Metal Fabrication Surfaces: Remove soil and foreign matter from finished surfaces and keep clean until the date of Final Acceptance.

3.6 PROTECTION

A. Metal Fabrications: Apply such protective coverings to prevent damage until date of notice of Final Completion.

END OF SECTION

SECTION 05 7313 - GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glass- and plastic-supported railings at balconies and concrete stairs.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 06 1053 "Miscellaneous Rough Carpentry" for wood blocking for anchoring railings.
3. Section 09 2216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.3 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.4 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

C. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.

2. Grout, anchoring cement, and paint products.

C. LEED Submittals:

1. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings: Include plans, elevations, sections, and attachment details.

E. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.

2. Each type of glass required.

3. Fittings and brackets.

F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 QUALITY ASSURANCE

A. Provide the following upon request:

1. Qualification Data: For professional engineer.

2. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

4. Preconstruction test reports.

5. Evaluation Reports: For post-installed anchors, from ICC-ES.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups as shown on Drawings.

2. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Julius Blum & Co., Inc.

2. C. R. Laurence Co., Inc.

3. Livers Bronze Co.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. See Section 01 6000 "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design railings, including attachment to building construction.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.

2. Stainless Steel: 60 percent of minimum yield strength.

3. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."

C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
   b. Infill load and other loads need not be assumed to act concurrently.
3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Sheet, Strip, Plate, and Flat Bar: ASTM A 666 or ASTM A 240/A 240M, Type 304.

D. Bars and Shapes: ASTM A 276, Type 304.

2.5 STEEL AND IRON

A. Tubing: ASTM A 500/A 500M (cold formed) or ASTM A 513.

B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

2.6 GLASS AND GLAZING MATERIALS

A. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.

B. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.

1. Glass Color: Clear.
2. Thickness: As indicated on Drawings.

C. Laminated Glass: ASTM C 1172, Condition A (uncoated), Type I (transparent flat glass), Quality-Q3 with two plies of glass and polyvinyl butyral interlayer not less than 0.060 inch thick.

1. Kind: LT (laminated tempered).
2. Glass Color: Clear.
3. Interlayer Color: Clear.
4. Glass Plies for Glass Infill Panels: Thickness required by structural loads, but not less than 5.0 mm each.

D. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction . Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

E. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.

1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.

F. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.7 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
2. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.8 MISCELLANEOUS MATERIALS

A. Low-Emitting Paints and Coatings: Paints and coatings applied to interior decorative metal railings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.9 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

H. Form changes in direction as follows:

1. As detailed.

I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of hollow railing members with prefabricated end fittings.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.10 GLAZING PANEL FABRICATION

A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.

2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

B. Infill Panels: Provide tempered laminated, tempered glass panels.

2.11 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.12 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

A. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.4 INSTALLING GLASS PANELS

A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.

1. Attach base channel to building structure, then insert and connect factory-fabricated and -assembled glass panels if glass was bonded to base and top-rail channels in factory.

2. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement unless glass was bonded to base and top-rail channels in factory.

a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.

3. Adjust spacing of glass panels so gaps between panels are equal before securing in position.

4. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

B. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 05 7500 - DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal base.

B. Related Requirements:

1. Section 07 6200 "Sheet Metal Flashing and Trim" for items made of formed metal for flashings and trim.
2. Section 07 7100 "Roof Specialties" for items made of formed metal for parapets and copings.

1.3 COORDINATION

A. Coordinate installation of anchorages for decorative formed metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes of deterioration.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product, including finishing materials.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachment details.
2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

E. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- square Samples of metal of same thickness and material indicated for the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative formed metal similar to that indicated for this Project and with a record of successful in-service performance as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

C. Provide the following upon request:

1. Qualification Data: For fabricator.
2. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METAL

A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

2.3 MISCELLANEOUS MATERIALS

A. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal, will prevent telegraphing and oil-canning, and is compatible with substrate and noncombustible after curing.

1. Contact Adhesive: VOC content of not more than 80 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.

G. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.5 METAL BASE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Moldings MX Base Molding.

B. Form metal base from metal of type and thickness indicated below:

1. Stainless-Steel Sheet: 0.063 inch.
   a. Finish: No. 4.

C. Adhesive application.

2.6 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with water and soap, rinsing with clean water, and drying with soft cloths.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 06 1053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood blocking, cants, and nailers.
2. Plywood backing panels.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups"
2. Section 06 1600 "Sheathing."
3. Section 06 2013 "Exterior Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. WCLIB: West Coast Lumber Inspection Bureau.
2. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. LEED Submittals:

1. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

3. Laboratory Test Reports for Credit IEQ 4: For plywood, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

B. Provide the following upon request:

1. Evaluation Reports: For the following, from ICC-ES:
   a. Power-driven fasteners.
   b. Powder-actuated fasteners.
   c. Expansion anchors.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: Lumber and plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Rooftop equipment bases and support curbs.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:

1. Hem-fir; WCLIB or WWPA.
2. Western woods; WCLIB or WWPA.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.3 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

C. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

D. Do not splice structural members between supports unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 1600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups"
2. Section 06 1053 "Miscellaneous Rough Carpentry" for plywood backing panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each stack or bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings:
   a. Indicated by design designations from GA-600, "Fire Resistance Design Manual."
   b. Comply with UL Fire Resistance Directory.

2.2 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation; GlasRoc.
   b. G-P Gypsum Corporation; Dens-Glass Gold.
   c. National Gypsum Company; Gold Bond e(2)XP.
   d. United States Gypsum Co.; Securock.
2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing:

1. As required and approved by the Air Barrier Manufacturer.
2. Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
3. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ~~ICC's "International~~ California Building Code."

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.

2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.

3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to air barrier and sheathing manufacturers' written instructions.

1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION

SECTION 06 2013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior wood trim.
2. Exterior Porch Canopy.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
2. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.

C. Samples for Verification:

1. For each species and cut of lumber and panel products, with 1/2 of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.

1.4 QUALITY ASSURANCE

A. Provide the following upon request:

1. Compliance Certificates:

a. For lumber that is not marked with grade stamp.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.6 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Certified Wood: The following wood products shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Exterior trim.

2. Exterior porch lumber .

B. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

C. Hardwood: IPE

2.2 EXTERIOR TRIM

A. Lumber Trim for Clear Finish:

1. Species and Grade: Ipe

2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.

3. Finger Jointing: Not allowed.

4. Face Surface: Surfaced (smooth).

2.3 EXTERIOR PORCH CANOPY

A. Framing: Ipe.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.

1. For applications not otherwise indicated, provide stainless-steel fasteners.

2.5 FABRICATION

A. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

2.6 FINISHING

A. Ipe Oil finish by DeckWise.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.

2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

3. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 FINISHING

1. Finish Ipe porch canopy lumber with Ipe oil.

2. Apply oil to each face of lumber prior to installation.

3.5 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 06 4113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Architectural wood cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.
3. Shop finishing of architectural wood cabinets.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products cabinet hardware and accessories and finishing materials and processes.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
    a. Include statement indicating location of manufacturer and distance to Project for

each regionally manufactured material.

b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.

4. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.

5. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

6. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.

2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

3. Show locations and sizes of cutouts and holes for electrical switches and outletsand other items installed in architectural wood cabinets.

4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

5. Apply WI Certified Compliance Program label to Shop Drawings.

D. Samples for Verification:

1. Lumber for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.

2. Veneer leaves representative of and selected from flitches to be used for transparent-finished cabinets.

3. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.

B. Installer Qualifications: Licensee of WI's Certified Compliance Program.

C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

D. Accessibility: Comply with requirements of the 2010 ADA Standards and 2016 CBC 11B for cabinet hardware and operating force.

E. Provide the following upon request:

1. Qualification Data: For fabricator.

2. Product Certificates: For each type of product.

F. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of typical architectural wood cabinets as shown on Drawings.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate

measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood-veneer-faced architectural cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOOD CABINETS, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural wood cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.2 WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Premium.

B. Regional Materials: Wood cabinets for transparent finish shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

C. Certified Wood: Wood cabinets for transparent finish shall be produced from wood certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

D. Type of Construction: Frameless.

E. Cabinet and Door and Drawer Front Interface Style: Flush overlay .

F. Wood for Exposed Surfaces: As indicated in the Interior Finishes and Materials Legend

G. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
3. Drawer Bottoms: Hardwood plywood.

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
2. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
2. Medium-Density Fiberboard: ANSI A208.2, Grade 130 , made with binder containing no urea formaldehyde.
3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
4. Softwood Plywood: DOC PS 1, medium-density overlay.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 711110 "Door Hardware."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Wire Pulls: Back mounted, solid metal, size to provide accessibility without grasping, pinching or twisting. Comply with 2016 CBC 11B.309.4.

D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

E. Shelf Rests: BHMA A156.9, B04013; metal.

F. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.

3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.

4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.

5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.

6. For computer keyboard shelves, provide Grade 1HD-100.

7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.

G. Door Locks: BHMA A156.11, E07121.

H. Drawer Locks: BHMA A156.11, E07041.

I. Door and Drawer Silencers: BHMA A156.16, L03011.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

2. Satin Stainless Steel: BHMA 630.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FABRICATION

A. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets: 1/16 inch unless otherwise indicated.

B. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Cabinet Doors:

1. Doors Up To 80 Inches High: 3/4 inch thick panel product.

2. Doors Over 80 Inches High: 1-3/8" thick solid-core, premium grade, 3 or 5 ply, particleboard core with stiles and rails bonded to core, WDMA I.S.1-A standard duty. Face finish same as custom cabinets. Comply with AWI Section 9.

2.7 SHOP FINISHING

A. General: Finish architectural wood cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing

architectural wood cabinets, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

D. Transparent Finish:

1. Grade: Premium.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. For shop finished items use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Maintain veneer sequence matching of cabinets with transparent finish.

3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

G. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 06 4116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 06 100053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 12 3623.13 "Plastic-Laminate-Clad Countertops."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products high-pressure decorative laminate and cabinet hardware and accessories.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
    a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.

3. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
4. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
5. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
6. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outletsand other items installed in architectural plastic-laminate cabinets.
4. Apply WI Certified Compliance Program label to Shop Drawings.

D. Samples for Verification:
1. Plastic laminates, 12 by 12 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
2. Thermoset decorative panels, 12 by 12 inches, for each color, pattern, and surface finish, with edge banding on one edge.
3. Corner pieces as follows:
   a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
   b. Miter joints for standing trim.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.

B. Installer Qualifications: Licensee of WI's Certified Compliance Program.

C. Accessibility: Comply with requirements of the 2010 ADA Standards and 2013CBC 11B for cabinet hardware and operating force.

D. Provide the following upon request:

1. Qualification Data: For fabricator.

2. Product Certificates: For each type of product.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 08 71110 "Door Hardware" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Custom.

C. Regional Materials: Plastic-laminate cabinets shall be manufactured within 500 miles of Project site.

D. Certified Wood: Plastic-laminate cabinets shall be made from wood products certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

E. Type of Construction: Frameless.

F. Cabinet, Door, and Drawer Front Interface Style: Flush overlay .

G. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

H. Laminate Cladding for Exposed Surfaces:

1. As indicated in the Interior Finishes and Materials Legend

2. Horizontal Surfaces: Grade HGS.

3. Vertical Surfaces: Grade HGS.

4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.

5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

I. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS Thermoset decorative panels.
   a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
   b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
   c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade CLS.
2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

J. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

K. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

L. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

M. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130 , made with binder containing no urea formaldehyde.
2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
3. Softwood Plywood: DOC PS 1, medium-density overlay.

4. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 7111 "Door Hardware (Descriptive Specification)."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Back-Mounted Pulls: BHMA A156.9, B02011. Size to provide accessibility without grasping, pinching, or twisting. Comply with 2013 CBC 11B.309.4.

D. Wire Pulls: Back mounted, solid metal, size to provide accessibility without grasping, pinching, or twisting. Comply with 2013 CBC 11B.309.4.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal.

G. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
5. For drawers more than 6 inches high or more than 24 incheswide, provide Grade 1HD-200.
6. For computer keyboard shelves, provide Grade 1HD-100.
7. For trash bins not more than 20 inches high and 16 incheswide, provide Grade 1HD-200.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Door and Drawer Silencers: BHMA A156.16, L03011.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

2. Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Cabinet Doors:

1. Doors Up To 80 Inches High: 3/4 inch thick panel product.

2. Doors Over 80 Inches High: 1-3/8" thick solid-core, custom grade, 3 or 5 ply, particleboard core with stiles and rails bonded to core, WDMA I.S.1-A standard duty. Face finish same as custom cabinets. Comply with AWI Section 9.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 06 4400 - ORNAMENTAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior custom ornamental woodwork.
2. Wood furring, blocking, shims, and hanging strips for installing ornamental work items unless concealed within other construction before woodwork installation.
3. Shop finishing of interior ornamental woodwork.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing ornamental woodwork and concealed within other construction before ornamental woodwork installation.
2. Section 06 2013 "Exterior Finish Carpentry" for exterior carpentry exposed to view that is not specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products and finishing materials and processes.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured and regionally extracted and manufactured materials. Include statement indicating cost for each regionally manufactured material.
    a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
5. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
6. Product Data for Credit IEQ 4.4: For adhesives and CARB II compliant composite wood products, documentation indicating that products contain no urea formaldehyde.
7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
    1. Show details full size.
    2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
    3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
    4. Apply WI Certified Compliance Program label to Shop Drawings.

D. Samples for Verification:
    1. Lumber for transparent finish, not less than 5 inches wide by 24 inches long, for each species and cut, finished on one side and one edge.
    2. Veneer leaves representative of and selected from flitches to be used for transparent-finished ornamental woodwork.

1.5 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.

B. Installer Qualifications: Licensee of WI's Certified Compliance Program.

C. Provide the following upon request:

1. Qualification Data: For Installer fabricator.

2. Product Certificates: For each type of product.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver interior ornamental woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If ornamental woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations for Interior Work: Do not deliver or install interior ornamental woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where ornamental woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where ornamental woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that ornamental woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ORNAMENTAL WOODWORK FABRICATORS

A. Fabricators: Subject to compliance with requirements, provide products by the following:

1. ISEC
2. 9Wood

2.2 ORNAMENTAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of ornamental woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.3 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. Interior ornamental work for transparent finish includes the following:

1. Decorative wood grille wall slats.
2. Decorative wood grille Atrium slats.
3. Decorative wood grille ceiling slats.

B. Grade: Premium.

C. Certified Wood: Interior ornamental work for transparent finish shall be produced from wood certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

D. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.

1. Species: See Interior Finishes and Materials Legend.

2.4 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of ornamental woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content for Interior Materials: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of ornamental woodwork and quality grade specified unless otherwise indicated.

1. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
2. Medium-Density Fiberboard: ANSI A208.2, Grade 130 , made with CARB II compliant binder containing no urea formaldehyde.
3. Particleboard: ANSI A208.1, Grade M-2 Grade M-2, made with CARB II compliant binder containing no urea formaldehyde.
4. Softwood Plywood: DOC PS 1, medium-density overlay.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

2.5 MISCELLANEOUS MATERIALS

A. Interior Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Screws for Exterior Use: stainless steel.

C. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

E. Adhesives: Do not use adhesives that contain urea formaldehyde.

F. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Structural Wood Member Adhesive: 140 g/L.
4. Architectural Sealants: 250 g/L.

2.6 FABRICATION

A. Fabricate ornamental woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

B. Complete fabrication, including assembly and finishing, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times ornamental woodwork fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

2.7 SHOP FINISHING

A. General: Finish ornamental woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Transparent Finish for Interior Items:

1. Grade: Premium.

2. Finish: System - 4, water-based latex acrylic.

3. Staining: Match approved sample for color.

4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition ornamental woodwork to average prevailing humidity conditions in installation areas.

B. Before installing ornamental woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install ornamental woodwork to comply with same grade as item to be installed.

B. Assemble ornamental woodwork and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install ornamental woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut ornamental woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor ornamental woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with ornamental woodwork.

1. For shop-finished items, use filler matching finish of items being installed.

F. Touch up finishing work specified in this Section after installation of ornamental woodwork. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective ornamental woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace ornamental woodwork. Adjust joinery for uniform appearance.

B. Clean ornamental woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 06 6400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood furring for installing plastic paneling.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

2. Product Data for Credit IEQ 4.4: For laminating adhesive used in factory-laminated plastic panels, documentation indicating that product contains no urea formaldehyde.

3. Laboratory Test Reports for Credit IEQ 4.1: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

5. Laboratory Test Reports for Credit IEQ 4.6: For wall panels, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Crane Composites, Inc.
   b. Newcourt, Inc.
   c. Nudo Products, Inc.
2. Low-Emitting Materials: Paneling shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.
4. Nominal Thickness: Not less than 0.12 inch.
5. Surface Finish: Smooth.
6. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Match panels.

B. Adhesive: As recommended by plastic paneling manufacturer and with a VOC content of 50 g/L or less.

C. Adhesive: As recommended by plastic paneling manufacturer and that complies with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 9200 "Joint Sealants."

1. Sealant shall have a VOC content of 250 g/L or less.

2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at panel joint locations for accurate installation.

2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive .

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 07 1326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.
2. Molded-sheet drainage panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, adhesion to contaminated substrate (e.g. concrete curing compounds and form release agents), substrate curing period weather related restrictions during installation, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.The Contractor: Include the following activities:
    a. Before starting application of membrane waterproofing work, arrange a job-site meeting with the Architect, the Testing Agency and manufacturer representative to discuss the following:
        1) The waterproofing system, number of plies, termination and flashing requirements.
        2) Intermediate and final requirements of protecting the work.
        3) The different substrates that will receive the waterproofing and preparation requirements for each.
        4) Curing requirements for concrete.
        5) Concrete form release agent precautions.
        6) Adhering to coated surfaces, if applicable.
        7) Job specific recommendations on use of primers.
        8) Hot, cold and wet condition precautions.
        9) Scheduling and coordination with other construction, such as waterproofing overlaps that must be installed during construction of walls and footings both above and below grade.
        10) Protection of the work and repair procedures.
        11) Verify in writing to the Owner's representative, that the contractor's full time on site foreman and crew etc. (as required) are certified, or meet the requirements of the manufacturer of the waterproofing, as installers.

b. Whenever the membrane waterproofing work is to be done, notify Testing Agency in sufficient time to arrange inspections.

c. Provide safe access to the location of the Work for proper inspection.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.

2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

C. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

D. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Provide the following upon request:

1. Qualification Data: For Installer.

2. Field quality-control reports.

C. Mockups: Build mockups to set quality standards for installation.

1. Build for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatment, corner treatment, and protection.

a. Size: 100 sq. ft. in area or as required to demonstrate typical waterproofing detailing.

b. Description: Each type of wall installation.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Quality Assurance / Quality Control Program:

1. Cooperate with independent testing and inspection agencies engaged by the Owner. Do not cover waterproofing until it has been inspected and accepted. The following daily inspection and daily work sheet paragraphs are to occur for each day of installed waterproofing system and each day of backfill.

2. Daily Inspection:

a. Visual inspection of the substrate prior to the application of membrane to confirm the substrate is in accordance with the manufacturer's instructions.

b. Visual inspection on the completed waterproofing for that day and fix any deficiencies.

3. Daily Work Sheet: At a minimum include the following:

a. Listing of installers

b. Project Name

c. Waterproofing product name and lot/batch number

d. Primer product name and lot/batch number

e. Substrate type

f. Substrate preparation required, include photo documentation of deficient substrates and substrate repairs.

g. Installation locations (grid lines, elevations, etc)

h. Results of visual inspection

i. Results of verification that backfilling procedures do not pull the waterproofing system down the wall, include photo documentation.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

C. Compatibility:

1. Where new work interfaces existing waterproofed construction, remove existing waterproofing as required to install new work. Interface new waterproofing with existing system to provide continuous system without leaks. Ensure compatibility of system materials.

2. The waterproofing manufacturer shall submit a letter stating compatibility or concerns with existing, or adjacent, waterproofing.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials and molded-sheet drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer that complies with VOC limits of authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide the following:
   a. Carlisle Coatings & Waterproofing Inc; CCW MiraDRI 860/861.
   b. Grace Construction Products; W.R. Grace & Co. -- Conn; Bituthene 3000/Low Temperature.
   c. Polyguard Products, Inc; Polyguard 650.
   d. Soprema; Colphene 3000.
2. Physical Properties:
   a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
   b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
   c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
   d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
   e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
   f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
   g. Water Vapor Permeance: 0.05 perms maximum; ASTM E 96/E 96M, Water Method.
   h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

D. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

E. Sheet Strips: Self-adhering, rubberized-asphalt sheet strips of same material and thickness as sheet waterproofing.

F. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

G. Metal Termination Bars:

1. Termination Bar: Stainless Steel 1-inch by 8-feet, 0.075• • -inch thick, with 5/16• • -inch holes, 8-inch• • to 9-inch• • on center. Basis of design: Advanced Building Products Inc. Stainless Steel Termination Bar.

2. Expansion Anchor: 1/4-inch x 2-inch• • expansion anchor consisting of a Type 304 Stainless Steel drive pin and an expanding body. Basis of design: Hilti Metal HIT Anchor.

H. Foil Faced Modified Bituminous Strip: 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Type 1: Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 18 gpm per ft. (112 to 220 L/min. per m112 to 220 L/min. per m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Carlisle Coatings & Waterproofing; CCW MiraDRAIN 6200.
   b. Grace Construction Products; W.R. Grace & Co. -- Conn; Hydroduct 220 (vertical), Hydroduct 660 (horizontal).
   c. Polyguard Products, Inc.; Polyguard Flow 15.
   d. Soprema; Sopradrain 10G.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.

2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks.

F. Bridge and cover isolation joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets, 100% back rolled, over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. One-Ply Application: Install sheets to form a membrane with lap widths of a uniform 2-1/2-inch (64-mm) minimum.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet-waterproofing terminations with mastic.

G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.5 FIELD QUALITY CONTROL

A. Site Representative: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect for each day of inspection.

B. Testing Agency: Owner to engage a qualified testing agency to inspect the waterproofing system installation to verify installation meets project requirements and manufacturers requirements. Furnish reports to Architect for each day of inspection. Include the following:

1. Substrate conditions.

2. Surface preparation and application of primer.
3. Waterproofing application, including joint and crack preparation, penetration detailing, laps and continuity of membrane, and termination of membrane.
4. Protection and drainage components.
5. Backfilling procedures to assure that backfilling does not pull the waterproofing system down the wall.

3.6 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 1413 - HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rubberized-asphalt waterproofing membrane reinforced.
2. Molded-sheet drainage panels.
3. Plaza-deck pavers.

B. Related Requirements:

1. Section 07 1326 "Self-Adhering Sheet Waterproofing" for foundation wall waterproofing.
2. Section 07 9200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, adhesion to contaminated substrate (e.g. concrete curing compounds and form release agents), substrate curing period weather related restrictions during installation, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.The Contractor: Include the following activities:
    a. Before starting application of membrane waterproofing work, arrange a job-site meeting with the Architect, the Testing Agency and manufacturer representative to discuss the following:
        1) The waterproofing system, number of plies, termination and flashing requirements.
        2) Intermediate and final requirements of protecting the work.
        3) The different substrates that will receive the waterproofing and preparation requirements for each.
        4) Curing requirements for concrete.
        5) Concrete form release agent precautions.
        6) Adhering to coated surfaces, if applicable.
        7) Job specific recommendations on use of primers.

8) Hot, cold and wet condition precautions.

9) Scheduling and coordination with other construction, such as waterproofing overlaps that must be installed during construction of walls and footings both above and below grade.

10) Protection of the work and repair procedures.

11) Verify in writing to the Owner's representative, that the contractor's full time on site foreman and crew etc. (as required) are certified, or meet the requirements of the manufacturer of the waterproofing, as installers.

b. Whenever the membrane waterproofing work is to be done, notify Testing Agency in sufficient time to arrange inspections.

c. Provide safe access to the location of the Work for proper inspection.

d. Post installation testing (e.g. Electronic Field Vector Mapping.)

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For the following products:

1. Waterproofing System, 8 by 8 inches (200 by 200 mm), showing layering of membrane components (waterproofing membrane, reinforcing fabric, and protection course).

2. Flashing sheet, 8 by 8 inches (200 by 200 mm).

3. Insulation, 8 by 8 inches (200 by 200 mm).

4. Drainage panel, 4 by 4 inches (100 by 100 mm).

5. For plaza-deck pavers, 4 by 4 inches (100 by 100 mm) square) in each color and texture required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Sample field quality-control reports.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Install waterproofing to 100 sq. ft. of deck to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. Install pavers and paver supports to demonstrate aesthetic effects, and set quality standards for materials and execution.

1. For slopes greater than 2:12, mockup is required to test interface shear to determine the stability of the system "sandwich."

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Weather Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below zero deg F.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

C. Compatibility:

1. Where new work interfaces existing waterproofed construction, remove existing waterproofing as required to install new work. Interface new waterproofing with existing system to provide continuous system without leaks. Ensure compatibility of system materials.

2. The waterproofing manufacturer shall submit a letter stating compatibility or concerns with existing, or adjacent, waterproofing.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty includes removing and reinstalling protection course, drainage panels, insulation, pavers on plaza decks.

2. Warranty insulation retains 80 percent of original published thermal value.

3. Warranty pavers do not dish or warp and do not crack, split, or disintegrate in freeze-thaw conditions.

4. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WATERPROOFING MEMBRANE

A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. American Hydrotech, Inc; Monolithic Membrane 6125.

b. Soprema, Inc.; Colphene H

c. Tremco Incorporated; Tremproof 6100.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with waterproofing.

B. Primer: ASTM D 41/D 41M, asphaltic primer.

C. Elastomeric Sheet: 50-mil- minimum, uncured sheet neoprene with manufacturer's recommended contact adhesives, if applicable, as follows:

1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.

2. Elongation: 300 percent minimum; ASTM D 412.

3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.

4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.

D. Metal Termination Bar: Provide the following components.

1. Termination Bar: Stainless Steel 1inch by 8 feet, 0.075” thick, with 5/16” holes 8” to 9” on center. Basis of design: Advanced Building Products Inc. Stainless Steel Termination

Bar.

2. Expansion Anchor: 1/4" x 2” expansion anchor consisting of a Type 304 Stainless Steel drive pin and an expanding body. Basis of design: Hilti Metal HIT Anchor.

E. Sealants and Accessories: Manufacturer's recommended sealants and accessories.

F. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.

G. Protection Course:

1. Protection Course Horizontal and Vertical Applications: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners, 1/8-inch (3 mm) nominal thickness.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) American Hydrotech, Inc; Hydroflex 30.
      2) W. R. Meadows, Inc.; Sealtight PC-2.
      3) Soprema; Sopraboard 1/8".
      4) Tremco Incorporated; 2550 Protection Board.
   b. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.

2.3 MOLDED-SHEET DRAINAGE PANELS

A. Type 3: Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panels consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core, with a polymeric film bonded to the other side; and with a horizontal flow rate of not less than 2.8 gpm per ft. (35 L/min. per m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Hydrotech, Inc; Hydrodrain 990.
   b. Carlisle Coatings & Waterproofing, Inc; CCW MiraDRAIN 9900.
   c. JDR Enterprises, Inc.; J-Drain 990.

2.4 PLAZA-DECK PAVERS

A. Plaza-Deck Pavers: Heavyweight, hydraulically pressed, concrete units, square edged, manufactured for use as plaza-deck pavers; minimum compressive strength 5000 psi, ASTM C 140; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Stepstone, Inc. CalArc Drydeck roof pavers
   b. Hanover Architectural Products.
2. Thickness: 2-1/2 inches.

3. Face Size: 24 inches square.
4. Color: As selected by Architect from manufacturer's full range.
5. Paver Supports: Integral cast nubs on base of pavers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
   2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
   1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
   2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.
    a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of 6 inches on each side of joints and adhere to substrates in a layer of hot rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

3.4 FLASHING INSTALLATION

A. Install elastomeric sheets at terminations of waterproofing membrane according to manufacturer's written instructions.

B. Prime substrate with asphalt primer.

C. Install elastomeric sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.

D. Extend elastomeric sheet up walls or parapets a minimum of 8 inches above plaza-deck pavers and 6 inches onto deck to be waterproofed.

E. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of waterproofing.

3.5 MEMBRANE APPLICATION

A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow it to dry.

B. Heat and apply rubberized asphalt according to manufacturer's written instructions.

1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.

C. Start application with manufacturer's authorized representative present.

D. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils; embed reinforcing fabric, overlapping sheets 2 inches; spread another 125-mil- thick layer to provide a uniform, reinforced, seamless membrane 215 mils thick.

E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

F. Cover waterproofing with protection course with overlapped joints using adhesive before membrane is subject to construction or vehicular traffic.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.7 PLAZA-DECK PAVER INSTALLATION

A. Install concrete pavers according to manufacturer's written instructions.

B. Install pavers to not vary more than 1/16 inch in elevation between adjacent pavers or more than 1/16 inch from surface plane elevation of individual paver.

C. Maintain tolerances of paving installation within 1/4 inch in 10 feet of surface plane in any direction.

3.8 FIELD QUALITY CONTROL

A. Site Representative: Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; and application of membrane, flashings, protection, and drainage components; furnish daily reports to Architect.

1. Site representative shall measure membrane thickness with pin tester or other suitable device at least once for every 100 sq. ft. and include measurements in reports.

B. Testing Agency: Owner to engage a qualified testing agency to inspect substrate conditions, surface preparation, waterproofing application, protection, and drainage components, and to furnish reports to Architect.

C. Post Installation Testing: All waterproofed surfaces.

1. Electric Field Vector Mapping (EFVM): EFVM technician shall survey entire waterproofing area for potential leaks using EFVM.
    a. Install a temporary leak detection system by one of the following or approved equal:
        1) International Leak Detection, Ltd, Ontario, Canada
        2) Honza Group Incorporated, Columbia, Maryland
    b. Engage a company experienced in detecting breaches in the waterproofing using an electronic detection system.
    c. If breaches are discovered, repair the breach and retest the affected area. Repeat this process until no breach is detected.
2. Testing agency to observe testing. If breaches are discovered, the independent testing agency shall observe repairs and retesting of discovered breaches.

3.9 CLEANING AND PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 1800 - REINFORCED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes reinforced waterproofing for the following applications:

1. Concrete Window Sills: Partially reinforced application.
2. Pedestrian traffic: Reinforced application at surfaces at loading dock and stair landings.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 03 3000 "Cast-in-Place Concrete" for slab on grade application requiring a vapor retarder.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product, including installation instructions.

C. LEED Submittals:

1. Product Test Reports for Credit SS 7.2: For reinforced waterproofing that are roof coverings, documentation indicating compliance with Solar Reflectance Index requirement.
2. Product Data for Credit IEQ 4.2: For interior field-applied reinforced waterproofing, documentation including printed statement of VOC content.
3. Laboratory Test Reports for Credit IEQ 4: For interior reinforced waterproofing, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings: For reinforced waterproofing.

1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.

E. Samples for Verification: For each type of exposed finish, prepared on rigid backing.

1. Provide stepped Samples on backing to illustrate buildup of reinforced waterproofing.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For reinforced waterproofing to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Provide the following upon request:

1. Qualification Data: For Installer.
2. Product Certificates: For each type of reinforced waterproofing.
3. Field quality-control reports.

C. Mockups: Build mockups to set quality standards for materials and execution.

1. Build mockup for each reinforced waterproofing and substrate to receive reinforced waterproofing.
2. Size: 200 sq. ft. of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply reinforced waterproofing within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply reinforced waterproofing to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply reinforced waterproofing in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.

B. Do not install reinforced waterproofing until items that penetrate membrane have been installed.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace reinforced waterproofing that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Adhesive or cohesive failures.
   b. Abrasion or tearing failures.
   c. Surface crazing or spalling.
   d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Material Compatibility: Provide primers; base-, intermediate-, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Source Limitations:

1. Obtain reinforced waterproofing from single source from single manufacturer.
2. Obtain primary reinforced waterproofing materials, including primers, from reinforced waterproofing manufacturer. Obtain accessory materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of types and from sources recommended in writing by primary material manufacturer.

C. Reinforced Waterproofing: Manufacturer's standard, reinforced waterproofing, seamless, high-solids-content, cold liquid-applied, elastomeric, waterproofing membrane system with integral wearing surface.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Soprema Alsan Partially Reinforced System without aggregate.

2.2 TRAFFIC COATING

A. Manufacturer: Soprema Alsan RS.

B. Use: Pedestrian.

C. Preparatory and Base Coats: Apply base coat per manufacturer's written instructions.

D. Reinforced system.

E. Wear/Top Coat: Apply wear/top coat per manufacturer's written instructions (liquid membrane and aggregate) and back roll to encapsulate aggregate into liquid membrane.

1. Color: As selected by Architect from manufacturer's full range.
2. UV inhibitors: Use UV inhibitors when reinforced waterproofing is exposed to direct sunlight, as recommended by the reinforced waterproofing manufacturer.

F. Aggregate: Manufacturer's standard aggregate for each use indicated of particle sizes, shape, and minimum hardness recommended in writing by reinforced waterproofing manufacturer.

2.3 MATERIALS

A. Membrane/Flashing Waterproofing Materials

1. Primer: A PMMA-based primer for use over horizontal concrete substrates.
2. Flashing Resin: A thixotropic, flexible, acrylic, PMMA-based resin for use in combination with a fleece fabric to form a monolithic, reinforced flashing membrane used in conjunction with a reinforced or unreinforced waterproofing system.
3. Base Resin: A flexible, acrylic PMMA-based resin for use as waterproofing in a reinforced waterproofing system.
4. Fleece: A non-woven, needle-punched polyester fabric used as a reinforcement in PMMA-based flashing and field membrane systems.
   a. Nominal Thickness: 40 mils (1 mm)
   b. Weight: 110 grams per square meter
5. Color Finish: A pigmented, multi-component, PMMA-based resin for use as both an embedment and finish layer in waterproofing and flashing systems.

2.4 MATERIAL PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide reinforced waterproofing materials with the fire-test-response characteristics as determined by testing identical products per test method below for deck type and slopes indicated by an independent testing and inspecting agency that is acceptable to authorities having jurisdiction.

1. Class A roof covering per ASTM E 108 or UL 790.

B. VOC Content: Reinforced waterproofing shall have a VOC content of 150 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Low-Emitting Materials: Reinforced waterproofing shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 WATERPROOFING ACCESSORIES

A. Cleaning Solution/Solvent: A clear solvent used to clean and prepare transition areas of in-place catalyzed resin to receive subsequent coats of resin and to clean substrate materials to receive resin.

B. Paste: A PMMA-based paste used for remediation of depressions in substrate surfaces prior to the application of the waterproofing system.

C. Repair Mortar: A two-component, PMMA-based, aggregate filled mortar used for patching concrete substrates.

D. Catalyst: A peroxide-based reactive agent used to induce curing of PMMA-based resins.

E. Chip Surfacing Blend: A blend of flat, angular, pigmented polymer flakes broadcast into the color finish layer of the waterproofing system. The chip blend shall be supplied by the manufacturer of the waterproofing membrane.

F. Thixotropic Agent: A liquid additive used to increase the viscosity of the PMMA-based resin products, allowing the resins to be applied over vertical or sloped substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of reinforce waterproofing work.

B. Verify that substrates are visibly dry and free of moisture.

1. Test for moisture according to ASTM D 4263.
2. Test for moisture content by measuring with an electronic moisture meter.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of reinforced waterproofing work.

D. Proceed with installation only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

1. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by reinforced waterproofing manufacturer has passed and after substrates are dry.
2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. General: Before applying reinforced waterproofing, clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for reinforced waterproofingapplication. Remove projections, fill voids, and seal joints if any, as recommended in writing by reinforced waterproofing manufacturer.

B. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.

C. Mask adjoining surfaces not receiving reinforced waterproofing to prevent overspray, spillage, leaking, and migration of coatings. Prevent reinforced waterproofing materials from entering deck substrate penetrations and clogging weep holes and drains.

D. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D 4259. Do not acid etch.

1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
2. Remove concrete fins, ridges, and other projections.
3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through reinforced waterproofing and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

B. Apply reinforcing strip in reinforced waterproofing system where recommended in writing by reinforced waterproofing manufacturer.

3.5 APPLICATION

A. Apply reinforced waterproofing according to ASTM C 1127 and manufacturer's written instructions.

B. Apply the specified compositions for each type of reinforced waterproofing at locations as indicated on Drawings.

C. Start reinforced waterproofing application in presence of manufacturer's technical representative.

D. Verify that wet film thickness of each coat complies with requirements every 100 sq. ft..

E. Uniformly broadcast aggregate on coats specified to receive aggregate. Embed aggregate per system type and according to manufacturer's written instructions.

F. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces where reinforced waterproofing terminates beyond four (4) inches up the wall.

G. Cure reinforced waterproofing. Prevent contamination and damage during application and curing stages.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform the following field tests and inspections:

1. Materials Testing:
    a. Samples of material delivered to Project site shall be taken, identified, sealed, and certified in presence of Owner and Contractor.
    b. Testing agency shall perform tests for characteristics specified, using applicable referenced testing procedures.
    c. Testing agency shall verify thickness of coatings during reinforced waterproofing application for each 600 sq. ft. of installed reinforced waterproofing or part thereof.
2. If test results show reinforced waterproofing does not comply with requirements, remove and replace or repair the membrane as recommended in writing by reinforced waterproofing manufacturer and make further repairs after retesting until reinforced waterproofing installation passes.

B. Final reinforced waterproofing Inspection: Arrange for reinforced waterproofing manufacturer's technical personnel to inspect membrane installation on completion.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 PROTECTING AND CLEANING

A. Protect reinforced waterproofing from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 1913 - WATER REPELLENTS AND SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water repellents of the following types:

1. Penetrating water repellents.

B. Water repellents for the following types of surfaces:

1. Above-grade.
2. Vertical .
3. Concrete.

1.2 RELATED SECTIONS

A. Section 03 3000 - Cast-in-Place Concrete.

1.3 SUBMITTALS

A. Product Data: For each coating system indicated, including:

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Preparation instructions and recommendations.
3. Manufacturer's Information: Manufacturer's technical data bulletin and MSDS, including label analysis and instructions for handling, storing, and applying each coating material.

B. Third-party report confirming that recommended system has been tested in accordance with ASTM E 514 on similar substrate and reduced water absorption by a minimum of 90 percent in comparison to untreated specimen.

C. Certification by water repellent manufacturer that's products supplied comply with local regulations controlling VOC emissions.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Capable of providing field service representation during installation and who will approve application method.

B. Installer Qualifications: Installer experienced in performing this type of work and who has specialized in work similar to the type required for this project.

C. Field Sample:

1. Install at Project site or pre-selected area of building an area for field sample, as directed by Architect.
2. Provide mockup of at least 100 square feet to include surface preparation, sealant joint, and juncture details and allow for evaluation of concrete stain top coated with specified water repellent.
3. Conduct a minimum of three RILEM tests before and after the water repellent has been applied. Allow sealer to cure three days before completing the post-application test. At least one RILEM test should be performed on a mortar joint within the test area. The average water loss should never exceed 1 ml in 3 minutes or be less than 90 percent improvement when compared to test conducted prior to application of the stain.
4. Apply material in strict accordance with manufacturer's written application instructions.
5. Obtain written approval of field sample before start of material application, including approval of aesthetics, color, texture, and appearance.
6. Manufacturer's representative will review surface preparation, application, and workmanship.
7. Field sample will be the standard for judging workmanship on remainder of Project.
8. Field sample shall be maintained during construction for workmanship comparison.
9. Field sample shall not be altered, moved, or destroyed until Work is completed and approved by Architect.
10. Intermix enough product at one time to cover areas between architectural breaks. See manufacturer's technical data bulletin for application instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label:

B. Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

C. Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

D. Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

E. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 35 deg F and not above 100 deg F.

F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not apply coatings in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Application may continue during inclement weather if surfaces and areas to be coated are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

C. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instructions from the manufacturer:

1. Ambient air and surface temperature is less than 50 degrees F.
2. Concrete surfaces and mortar have cured less than 28 days.
3. Rain or temperatures below 50 degrees F are predicted within 24 hours.
4. Do not apply coatings when rain is expected less than 12-24 hours after installation
5. Application is earlier than 24 hours after surface has been wet.
6. Substrate is frozen or surface temperature is less than 50 degrees F.
7. Windy conditions exist that may cause water repellent to be blown onto surface not intended to be coated.

1.7 WARRANTY

A. Provide manufacturer's 5-year Water Repellent Warranty.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

B. Quantity: Furnish Owner with an additional three percent, but not less than 1 gal or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Prosoco, Inc. ~~Stand Off SLX100.~~

B. Penetrating Sealers - Clear, water-based, odorless, non-yellowing, penetrating, non-film forming water repellent sealer with the following minimum performance properties:

1. Depth of Penetration: >=3/8 inch.
2. Specific Gravity: 0.913
3. Flash Point: >80 degrees F.
4. Resistance to UV: Excellent Accelerated weathering 1500 hours - No change.

C. Interior Concrete: Interior concrete columns: Clear Coat

1. Prosoco Sure Klean Weather Seal

D. Exterior Concrete: ACIP-2B: Vertical Surfaces and Soffits: Clear Coat

1. Prosoco SLX100 Water & Oil Repellent

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Remove all dust, dirt, paint, bitumen, efflorescence, oil, pollution deposits, and curing, forming, and parting compounds, other contaminants prior to application. Use abrasive brush blast or high pressure water as necessary to achieve the required surface condition.

B. Allow power washed surfaces to dry three days prior to coating. Surface shall be dry to touch and show no visible signs of moisture prior to application of water repellent.

C. Protect adjoining work, including sealant bond surfaces, from spillage or over spray of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water repellent treatment have been installed and cured.

E. Water repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

3.3 APPLICATION

A. Vertical Surfaces:

1. Apply protective treatment in a single, saturating application without atomizing the product. Use enough to thoroughly wet the surface and create a slight rundown below the spray pattern. Apply uniformly. Don't over apply.

2. Brush heavy runs and drips thoroughly into the surface.

B. Horizontal Surfaces:

1. Apply protective treatment in a single application without atomizing the product. Use enough material to keep the surface wet for about a minute before penetrating.

2. Broom out puddles thoroughly until they completely penetrate the surface.

3. Wipe down excess with a clean, absorbent towel.

C. Follow application method and rate established by Test Area. Apply a second saturation spray coating, if required, repeating first application. Comply with manufacturers written instructions for limitations on drying time between coats. Consult manufacturer's technical representative if written instructions are not applicable to project conditions.

3.4 FIELD QUALITY CONTROL

A. Manufacturers Field Service: Provide service of a factory authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

3.5 CLEANING

A. Protective Covering: Remove protective coverings from adjacent surfaces and other protective areas.

B. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water repellent application as work progresses. Repair damage caused by water repellent application. Comply with manufacturers written cleaning instructions.

END OF SECTION

SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rigid foam-plastic board insulation.
2. Semi-rigid mineral-wool board insulation.
3. Glass-fiber blanket insulation.
4. Mineral-wool blanket insulation.
5. Spray-applied cellulosic insulation.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups"
2. Section 06 1600 "Sheathing" for board sheathing over wood or steel framing.
3. Section 07 2726 Fluid-Applied Membrane Air Barriers for air and water barriers specified as a part of these systems.
4. Section 07 8446 "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product indicated.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

D. Fire Test Reports: Provide NFPA 285 assembly test report.

1.4 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Provide the following upon request:

1. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in their original containers or packages or bundles bearing label clearly identifying manufacturer's name, brand, grade, UL listing, and other pertinent information.

B. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

C. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

B. XPS-1: Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below; thickness and width indicated and manufacturer's standard length as required to suit job conditions; with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The).
b. Owens Corning.

2. Minimum thermal resistance (R) of 5.0 deg. F x h x sq. ft./Btu at mean temperature of 75 degrees F.

3. Type IV, 25 psi.

C. XPS-4: High Density Extruded-Polystyrene Board Insulation: ASTM C 578, Type V, 100 psi minimum compressive strength; with the following characteristics:

1. Minimum thermal resistance (R) of 5.0 deg. F x h x sq. ft./Btu at mean temperature of 75 degrees F.

2. Water absorption not more than 0.05 percent by volume.

3. Products: Subject to compliance with requirements, provide the following products:
a. Dow Chemical Company (The); Styrofoam Brand Highload 100.
b. Owens Corning; Foamular 100.

4. Provide protection board for rigid insulation under paving and flooring: 1/4 inchtempered hardboard complying with ANSI A135.4, Type I.
a. Tape for protection board: Polyethylene film with pressure-sensitive adhesive on one side, approved by manufacturer of rigid insulation.

D. XPS-5: High R-value Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 25 psi (173 kPa) minimum compressive strength; with the following characteristics:

1. Minimum thermal resistance (R) of 5.6 deg. F x h x sq. ft./Btu (0.88 K x sq. m/W) at mean temperature of 75 degrees F (24 degrees C).

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Dow Chemical Company (The); Styrofoam Brand Cavitymate Ultra.
b. Owens Corning; Foamular High-R CW Plus.

3. Thermal Resistance: Of total thickness required to provide a minimum thermal resistance of R-14 .

E. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.2 MINERAL-WOOL BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Fibrex Insulations Inc.

2. Isolatek International.

3. Owens Corning.

4. Roxul Inc.

5. Thermafiber.

B. MW-3: Unfaced, Mineral-Wool Rain Screen/Cavity Wall Insulation: ASTM C 612; thickness as indicated with width and length as required to suit job conditions; with maximum flame-spread and smoke-developed indexes of zero and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Required for use in exterior rain screen/cavity wall applications.

1. Characteristics:
   a. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
   b. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), Type II, thermal resistivity of 4.16 deg F x h x sq. ft./Btu x in. at 75 deg F (28.8 K x m/W at 24 deg C).
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Thermafiber; RainBarrier HD Insulation.
   b. Roxul Inc.; CavityRock.
3. Thermal Resistance: Of total thickness required to provide a minimum thermal resistance of R-14 (deg. F.h.sf/Btu).

2.3 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Johns Manville.
2. Knauf Insulation.
3. Owens Corning.

B. [FG-9:]Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; thickness as indicated with width and length as required to suit job conditions; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.4 MINERAL-WOOL BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Fibrex Insulations Inc.

2. Owens Corning.

3. Roxul Inc.

4. Thermafiber.

B. MW-4: Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; thickness as indicated with width and length as required to suit job conditions; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Minimum density of 0.6 lbs. per cubic foot.

2.5 SPRAY-APPLIED CELLULOSIC INSULATION

A. SAC-1: Self-Supported, Spray-Applied Cellulose Insulation: ASTM C 1149, Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications), chemically treated for flame-resistance, processing, and handling characteristics.

1. Basis of Design Product: K-13 by International Cellulose Corporation.

2. Thickness: As indicated.

B. Spray Applied Insulation Coating: Spray-applied, water based vinyl acrylic emulsion containing interlacing/bridging fibers forming a protective white coating over fibrous surfaces.

1. Basis of Design Product: Protek-13 by International Cellulose Corporation.

2.6 INSULATION FASTENERS

A. Mechanically Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
   b. Gemco; Spindle Type.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.

3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

B. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
   b. Gemco; Spindle Type.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inchin diameter; length to suit depth of insulation indicated.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inchessquare or in diameter.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, air barrier, fasteners, and substrates. When in contact with air barrier, provide adhesive and chemical compatible material that is acceptable by the air barrier manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Corning Corp.
   b. Momentive Performance Materials, Inc.
   c. Tremco Incorporated

2. Adhesion Strength: 15 lbf/sq. in. (207 kPa) minimum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF RAIN SCREEN/CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 12 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation

between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 2000 "Unit Masonry."
2. Over concrete surfaces impale semi-rigid insulation over mechanical fasteners. Install insulation to fasteners with speed fasteners or clips.
3. Butter all edges of insulation board with adhesive or fill joints with spray foam sealant.
4. Fill all voids with spray foam sealant.

B. Mineral-Wool Board Insulation: Adhesively attach to substrate or mechanically attach impaling pin through exterior sheathing into steel stud. Space impaling pins per manufacturer to resist the weight of the Mineral-Wool Board and the wind load. Fit insulation with edges butted tightly in both directions. Fit insulation tightly around cladding attachments and other obstructions. Press units onto impaling pins and firmly against exterior surface of wall. Install locking washer onto impaling pin.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members and/or building construction with no gaps or voids.
3. Secure insulation blankets to framing members with fasteners as recommended by the insulation manufacturer.
4. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
    a. Provide galvanized metal furring or metal bands or wire lacing as required to hold insulation blankets in place without sagging.

3.5 MISCELLANEOUS VOIDS

A. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials, matching adjacent insulation type where possible:

1. Unfaced glass-fiber blanket insulation. ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
2. Unfaced mineral-wool blanket insulation. ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

3.6 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches up either side of partitions.

3.7 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions and UL Fire Resistance Directory.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 2726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fluid-applied, vapor-permeable membrane air barriers, that incorporates the ABAA Quality Assurance Program.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Include installers of other construction connecting to air barrier, including roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and protection and repairs.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
2. Submit letter from primary materials manufacturer indicating approval of products not manufactured by primary manufacturer.
3. Include statement that materials are compatible with adjacent materials proposed for use.
4. Submit reports indicating that field peel-adhesion test on all materials to which sealants are adhered have been performed and the changes made, if required, to other approved materials, in order to achieve successful adhesion.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For air-barrier products used interior of the weatherproofing system, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For air barriers products used interior of the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include project specific details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include project specific details of interfaces with other materials that form part of air barrier.
3. Include letter from manufacturer indicating that the project specific details and shop drawings have been reviewed and are approved for use.

D. Field Test Results: Submit mockup and in-situ test results of air leakage test and water leakage test with specified standards, including retesting if initial results are not satisfactory.

E. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.

1. Provide evidence from the manufacturer that the firm is approved, authorized, or licensed to install the specified products and is eligible to receive manufacturer's special warranty.
2. Provide evidence that the installing firm is experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

3. Provide a manual that describes Installers and Manufacturers Quality Assurance / Quality Control program and procedures.
4. Sample of Installers Daily Work Sheet.
5. Submit evidence of current accreditation and certification under the Air Barrier Association of America's (ABAA) Quality Assurance Program. Submit accreditation number of manufacturer and certification number of installers.

F. Product Certificates: From air-barrier manufacturer, certifying permanent chemical and adhesive compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier, and certifying that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.

G. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

H. Fire Test Reports: Provide NFPA 285 assembly test report.

I. Sample Warranty: Manufacturer and Installer sample warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. A qualified firm that is approved, authorized, or licensed by the manufacturer to install manufacturer's product, that is eligible to receive manufacturer's special warranty, and is experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
2. A firm that is an ABAA-licensed contractor and employs certified and registered installers.
3. A firm that complies with ABAA's Quality Assurance Program.
4. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Manufacturer Qualifications: A qualified manufacturer regularly engaged in manufacturing air barrier membranes.

C. Quality Assurance / Quality Control Program:

1. Implement the ABAA Quality Assurance Program requirements. Cooperate with ABAA inspectors and independent testing and inspection agencies engaged by the Owner. Do not cover air barrier until it has been inspected, tested and accepted.
2. Daily Inspection:
   a. Visual inspection of the substrate prior to the application of membrane to confirm the substrate is in accordance with the manufacturer’s instructions.
   b. Visual inspection on the completed air barrier for that day and fix any deficiencies.

c. Verification of manufactures specific Wet film thickness of installed work.

d. Adhesion Test as indicated in Field Quality Control.

3. Daily Work Sheet: At a minimum include the following:

a. Listing of installers

b. Project name

c. Type of air barrier installed

d. Air barrier product name and lot/batch number

e. Primer product name and lot/batch number

f. Substrate type

g. Substrate preparation required

h. Installation locations (gridlines, elevations, etc)

i. Results of visual inspection

j. Results of verification of wet film thickness, include photo documentation

k. Results of verification of adhesion testing, include photo documentation

4. Testing, Inspection, and Reporting as indicated in the Field Quality control.

D. Mockups: Before beginning installation of air barrier, build mockups to set quality standards for materials and execution[and for preconstruction testing].

1. Build mockups of exterior wall assembly as shown on Drawings , incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.

b. Include junction with roofing vapor retarder, building corner condition, and below-grade waterproofing where applicable.

c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

4. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.7 PRECONSTRUCTION TESTING

A. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Qualitative Air-Leakage Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber depressurization with detection liquids.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary ABAA evaluated materials and air-barrier accessories from single source ABAA evaluated manufacturer. Additional accessory products are acceptable for use provided they are approved by the primary air barrier manufacturer.

B. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

C. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.

D. Low-Emitting Materials: Air barriers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

C. Provide an air barrier assembly that withstands combined positive and negative design wind, fan and stack pressures on the envelope without damage or displacement, that transfers the load to the structure, and that does not displace adjacent materials under full load. Join air barrier system materials in an airtight and flexible manner to adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement.

2.3 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

A. (AB-1) Fluid-Applied, Vapor-Permeable Membrane Air Barrier:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corp.; Defend Air 200.
   b. Momentive Performance Materials; Elemax 2600 AWB.
2. Physical and Performance Properties:
   a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
   b. Vapor Permeance: Minimum 10 perms; ASTM E 96/E 96M.

c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Transition Membrane: Between Air Barrier Membrane and Other Adjacent Materials: Comply with both air barrier manufacturer's recommendations and adjacent material manufacturer's recommendations.

1. Liquid Flashing: Manufacturer's standard trowel grade liquid flashing.
   a. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.
2. High Temperature Modified Bituminous Strip: 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil-(0.1-mm-) thick polyethylene film with release liner backing.
   a. For use under metal copings and flashings directly exposed to the exterior.
3. Foil Faced Modified Bituminous Strip: 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil-(0.1-mm-) thick polyethylene film with release liner backing.
4. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
   a. Dow Corning Corporation; Silicone Transition Strip System.
   b. Momentive Performance Materials Inc.; US11000 UltraSpan.

C. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

D. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

E. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

F. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchor spacing of 9" on center minimum unless otherwise required by the manufacturer. Provide galvanized sheet metal backup plate at locations where adequate substrate is not available for securing the termination bar.

H. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07 9200 "Joint Sealants."

I. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.

2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.

3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

4. Verify that the minimum concrete drying period recommended by air barrier system manufacturer has passed. Perform moisture content testing as required by the air barrier system manufacturer to verify concrete is acceptable for installation of air barrier.

5. Verify that masonry joints are tooled and completely filled with mortar.

6. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION MEMBRANE INSTALLATION

A. General: Install transition membrane and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane, below grade waterproofing, and base flashing to ensure continuity of air barrier with roofing membrane.

2. Install manufacturer's recommended transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials as recommended by manufacturer.

D. At end of each working day, seal top edge of transition membrane to substrate with termination mastic.

E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition membrane so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Provide liquid membranes for manufacturer's that offer it as part of the air barrier system.
2. For manufacturers that do not offer a liquid flashing, use transition membrane method that is acceptable to the air barrier manufacturer and that is chemically and adhesively compatible with the adjacent construction.
    a. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material. Tool sealant along edges of extrusion.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

H. Seal transition membrane around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, transition membrane.

J. Seal exposed edges of transition membrane at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in transition membrane. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with transition membrane and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

1. Apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats as recommended by the manufacturer and as needed to achieve required bond, with adequate drying time between coats.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.

1. Apply to a total wet film thickness as required by the membrane manufacturer to meet the performance requirements indicated.

C. Apply transition membrane according to air-barrier manufacturer's written instructions.

D. Provide air barrier and accessories that are acceptable for use at horizontal surfaces without detrimental effects to material.

E. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

F. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Owner's Inspection and Testing/ABAA Audits: Cooperate with Owner's testing agency and ABAA auditors. Allow access to work areas and staging. Notify Owner's testing agency/ABAA auditor in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Daily inspection and testing may be required. Do not cover Work of this Section until testing and inspection is accepted.

C. Periodic Inspections: Arrange for air barrier system manufacturer's technical personnel to inspect installation weekly during periods of ongoing installation.

D. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements.

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in transition membranes have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Transition membranes are firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.

13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.

14. All penetrations have been sealed.

E. Field Tests:

1. Allow sufficient time for testing and inspection and provide a schedule in advance to the Testing Agency.

2. Whenever Work is to be done, notify Testing Agency in sufficient time to arrange inspections.

3. Provide to the Owner copies of Quality Assurance Program documentation including daily site reports completed by installers.

4. Membrane Adhesion Test: Air barrier will be tested for minimum air-barrier adhesion of 16 lbf/sq. in. (207 kPa) or to manufacturer's minimum adhesion level per substrates, whichever is greater. Test materials for adhesion in accordance with ASTM D 4541-02 using a Type 1 pull tester except that the disk used shall be 2-1/4-inches to 4-inches in diameter and the membrane shall be cut through to separate the material attached to the disk from the surrounding material. Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with ASTM D 4541.
   a. Test Locations: Once daily per substrate during installation and a minimum of 4 tests per major elevation per substrate.
   b. Provide an inspection report that indicates whether or not the air barrier material has met the minimum adhesion level requirement.

5. Qualitative Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber depressurization using detection liquids.
   a. Test Locations: Provide ten tests for each penetration type per 2500 sq. ft. of each substrate. Distribute test locations across all elevations.

6. Qualitative Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers. Testing to be performed concurrent with Quantitative Air-Leakage Testing.

7. Quantitative Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783.
   a. Test Locations:
      1) Perform one test for the first 2500 sq. ft. of installed material for each wall assembly type.
      2) Perform one subsequent test for every 7500 sq. ft. of installed material for each wall assembly type.
      3) Test locations to be selected by Architect.
   b. Test Size: 100 sq. ft. minimum.

c. Perform tests after cladding attachments have been installed but prior to the installation of cladding/veneer material.

d. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion

e. Provide an inspection report that indicates results.

8. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform static-air-pressure differential of 6.24 lbf/sq. ft., and shall not evidence water penetration.

a. Test Locations:

1) Perform one test for the first 2500 sq. ft. of installed material for each wall assembly type.

2) Perform one subsequent test for every 7500 sq. ft. of installed material for each wall assembly type.

3) Test locations to be selected by Architect.

4) Testing to be performed concurrent with Quantitative Air-Leakage Testing.

b. Test Size: 100 sq. ft. minimum.

c. Perform tests after cladding attachments have been installed but prior to the installation of cladding/veneer material.

d. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion

e. Provide an inspection report that indicates results.

F. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.

2. Remove and replace deficient air-barrier components for retesting as specified above.

3. Upon failure of testing:

a. Repair and retest area.

b. Provide an addition three tests for each occurrence of a failure.

G. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for longer than allowed by manufacturer, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.

2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

SECTION 07 4213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concealed-fastener, lap-seam metal wall panels.
2. Integrated louvers.

B. Related Sections:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 07 4213.23 "Metal Composite Material Wall Panels" for metal-faced composite wall panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review of procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

D. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

E. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Provide the following upon request:

1. Qualification Data: For Installer.

2. Product Test Reports: For each product, for tests performed by a qualified testing agency.

3. Field quality-control reports.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly as shown on Drawings, including corner, supports, attachments, and accessories.

2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

5. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.

b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories

required for weathertight installation.

B. Flush-Profile, Concealed-Fastener Metal Wall Panels : Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. CENTRIA Architectural Systems. Concept Series 260 (Basis of Design)

b. Morin; a Kingspan Group company. X-12 Wall Panel

3. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.040 inch.

b. Surface: Smooth, flat finish.

c. Exterior Finish: Three-coat fluoropolymer.

d. Color: As selected by Architect from manufacturer's full range.

4. Panel Coverage: 12 inches.

5. Panel Height: 0.875 inch .

2.3 INTEGRATED LOUVERS

A. Integrated louvers galvanized coated ~~16 gage~~ sheet steel with PVDF finish, gage as required.

1. CENTRIA Architectural Systems. Concept Series Horizontal Profile Louver.

2. Morin Corporation. X-12 louver blade panel.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inchthick.

2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with

flat-lock seams. Tin edges to be seamed, form seams, and solder.

3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.

2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

   a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Install screw fasteners in predrilled holes.
3. Locate and space fastenings in uniform vertical and horizontal alignment.
4. Install flashing and trim as metal panel work proceeds.
5. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
6. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
3. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

D. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: At transitions to adjacent wall construction, after installation is complete, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 4213.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal composite material wall panels.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Composite Material Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Provide the following upon request:

1. Qualification Data: For Installer.

2. Product Test Reports: For each product, tests performed by a qualified testing agency.

3. Field quality-control reports.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal composite material panel assembly as shown on Drawings, including corner, soffits, supports, attachments, and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

4. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.

B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal composite material panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures including rupturing, cracking, or puncturing.
    b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

2.2 METAL COMPOSITE MATERIAL WALL PANELS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

1. Products: Subject to compliance with requirements, provide the following:
   a. ALUCOBOND; 3A Composites USA, Inc.; Alucobond.
   b. Alpolic Metal Composite Materials; ACM

B. Aluminum-Faced Composite Wall Panels : Formed with 0.020-inch- thick, coil-coated aluminum sheet facings.

1. Panel Thickness: As indicated on Drawings.
2. Core: Fire retardant.
3. Exterior Finish: Three-coat fluoropolymer.

a. Color: As selected by Architect from manufacturer's full range.

C. Copper-Faced Composite Wall Panels <Insert drawing designation>: Formed with [12-oz./sq. ft.0.41-mm-thick] [14-oz./sq. ft.0.48-mm-thick] copper sheet facings.

D. Attachment Assembly Components: Formed from extruded aluminum.

E. Attachment Assembly: Clip Rainscreen principle system.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

2.4 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.

2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal composite material panels.
2. Install screw fasteners in predrilled holes.
3. Install flashing and trim as metal composite material panel work proceeds.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.

1. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

F. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated.

G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: At transitions to adjacent wall construction, after installation is complete, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.

D. Metal composite material wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 4229 - TERRA COTTA BAGUETTE/LOUVER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this section includes, but shall not be limited to, unitized (panelized) or stick built baguette/louver system, consisting of the following:

1. Internal aluminum spline.
2. Extruded hollow terra cotta baguettes/louvers.
3. Gaskets.
4. Anchors, fasteners, flashings, weather seals, cover plates and formed metal trim and other accessories required for a complete installation.
5. Aluminum fin plates.
6. Aluminum angle or clip attachments.

B. Related work:

1. Section 01 4339, Exterior Walls Mockups.
2. Division 3, Cast-in-place and precast concrete.
3. Division 4, Unit masonry assemblies.
4. Division 5, Cold-formed metal framing.
5. Division 6, Exterior sheathing, Rough Carpentry.
6. Division 7, Insulation, flashings, firestop systems, air and vapor barriers, and joint sealers.
7. Division 8, Exterior aluminum curtain wall framing, windows, glass, and glazing.
8. Division 10, Exterior sun control devices.

1.2 SYSTEM DESCRIPTION

A. Design Criteria: Terra cotta baguette/louver system shall be based on Construction Documents and Specifications which indicate sizes, profiles, finishes, and dimensional requirements and shall consist of:

1. Hollow terra cotta baguettes/louvers hung individually or unitized with internal aluminum spline(s).
2. Gaskets standard black between spline and baguette/louver to maintain position and prevent wind induced rattle.
3. Aluminum fin plates carry the baguette/louver, spline and gasket assembly, and attach back to the structure with aluminum clip angle or other shape specified.

4. Fin plates to be attached back to portions of the building structurally sufficient to carry the clay baguette/louver system and associated loads.

5. System shall be engineered.

1.3 PERFORMANCE REQUIREMENTS

A. General: Design, fabricate and install components so that the completed baguette/louver system will withstand live loads, and those stipulated by the Building Code in effect for this Project.

1. The system shall be attached to a structure whose deflections are limited to L/360 or 5/8• , whichever is less.

B. Movement: Design, fabricate and install system to withstand building and thermal movements including deflections, temperature change without buckling, distortion, joint failure, or undue stress on baguette/louver system components, anchors or permanent deformation of any kind.

1. Provide for thermal movement over an ambient temperature range of 120°F (49°C) and a surface temperature of 180°F (82°C).

C. Color/Finish: Terra cotta baguettes/louvers shall be fired clay materials that achieve their final through-body or glaze color and texture through a kiln firing process forming permanent bonds.

D. Testing:

1. Absorption (ASTM C67): 4.0% to 7.0%.

2. Modulus of Rupture (ASTM C99): 2,000 to 3,000 psi.

3. Weight (ASTM C67): 130 to 135 lbs/cu.ft.

4. Linear Coefficient of Thermal Expansion: 3.5 x 10-4 %.

5. Freeze and Thaw (ASTM C67): 300 cycles.

6. Hardness (Various Standard Colors): 7 to 9 Mohs scale.

7. Efflorescence (ASTM C67): Not effloresced.

8. Chemical Resistance (ASTM C126): No change in color or texture.

E. Fabrication Tolerances:

1. Dimensional Tolerance: 0.039 inch for any cut length up to 60 inches.

2. Height: Plus or minus 1/16 inch up to 10 inches; plus or minus 3/32 inch up to 15 inches.

3. Thickness, Cross Section of baguette/louver: Plus or minus 1/16 inch.

4. Straightness ("sweep"): plus or minus 0.25 percent of length.

5. Diagonal Flatness: Plus or minus 0.25 percent of diagonal.

6. Vertical Flatness: Plus or minus 1.0 percent of height.

7. Torsion: Plus or minus 0.25 percent of diagonal.

F. Aluminum support: refer to Division 8 for requirements.

1.4 SUBMITTALS

A. Shop Drawings: Complete shop drawings shall be submitted for approval prior to fabrication including:

1. Elevations for each condition indicating terra cotta baguette/louver type and location.
2. Section details, to convey proper fabrication/installation for terra cotta baguette/louver types.
3. Shop drawings for building structure to receive baguette/louver system to be coordinated with terra cotta baguette/louver system shop drawings.

B. Samples: 3 sets of the following samples in the selected finish and color.

1. Initial color, if custom, will be submitted on a 6”h x 6”w tile. Standard colors may be selected from manufacturer’s color box.
2. Two 12-inch long by full size profile of each type of baguette/louver. Samples shall represent the full range of color and texture proposed for the Work.

C. Product Data: Manufacturer’s latest published literature describing each product selection.

D. LEED Information:

1. Manufacturer shall supply a document on company letterhead stating:
   a. Material & Resources requirement 1
   b. Material & Resources requirement 2. .

E. Project Specific Tests: If Project Specific Test are required:

1. Manufacturer and fabricator to certify that performance tests specified have been performed and that products or systems, including finishes, comply with specified requirements.
2. Submit 2 copies of test reports, prepared by the testing agency, for each specified test showing required performance criteria and test results. Include reports of failures and remedial actions taken in test reports. Arrange with the testing agency to prepare test reports in accordance with reporting procedures described in the Project Specified Test Standards.

1.5 QUALITY ASSURANCE

A. Installer/Fabricator Qualifications: Engage an experienced Installer/Fabricator, who has specialized in the erection and installation of types of systems similar to that required for this Project, to erect the terra cotta baguette/louver system.

1. Installer/Fabricator shall be trained by the manufacturer and has engaged in similar work for a period of no less than 5 years.

B. Manufacturer's qualifications: Engage a Manufacturer experienced in the manufacture of terra cotta baguette/louver systems similar to those indicated for this Project, and with a record of successful in-service performance.

C. Single responsibility:

1. The baguette/louver system shall be provided by a single firm unless otherwise noted.
2. The baguette/louver system shall have been used on at least 5 projects.

D. Mockup: Provide one completely assembled baguette/louver area, as shown in the Construction Documents, installed with all related accessories, in composite configurations, and representative of the design as shown on the Drawings.

1. Product used to assemble the mockup shall be the same as that to be installed onto the building.
2. Extent of mockup shall be the same as that which will be provided in the final work.
3. Mockup shall be installed simulating actual construction conditions, including actual structural supports and connections. Use means, methods and techniques proposed for final installation.
4. Locate mockup in location as directed by the Architect.
5. Personnel assembling mockup shall be the same personnel that will perform the actual work at the project site.
6. Comply with requirements of Section 01 4339".

E. Pre-Installation Inspection: Installer to contact manufacturer of terra cotta baguette/louver system, Owner and Architect, prior to installation of terra cotta baguette/louver system if site conditions adverse to proper installation of the system exist.

1.6 HANDLING

A. Protect components from adverse job conditions prior to installation.

B. Protect components from other trades after installation.

C. Storage:

1. Store components on platforms or pallets, covered with tarpaulins or other suitable weather-tight ventilated covering. Store components so that water accumulations will drain freely.
2. Do not store terra cotta baguettes/louvers in contact with other materials that might cause staining, surface damage, or other deleterious effect.
3. Do not stack platforms or pallets one on top of another.

1.7 WARRANTY

A. Manufacturer shall warrant the material of this Section for a period of 5 years from date of Substantial Completion against possible material defects.

B. Installer shall warrant the workmanship of this Section for a period of 2 years from date of Substantial Completion against defects in Workmanship.

C. The installation warranty shall provide that the baguette/louver system will remain intact during the warranty period and that if any failures occur due to faulty installation practices, components of the system will be repaired or replaced as required to render the system like it existed at substantial completion, at no cost to the Owner.

D. The warranty shall cover labor and materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hollow terra cotta baguettes/louvers complying with the following:

1. Finish: Standard
2. Size: As indicated on the Drawings
3. Color: To be selected

B. Fasteners, clips, and fin plates: In accordance with manufacturer's recommendations to meet performance criteria specified.

C. Fin Plates/Framing:

1. Aluminum alloy 6063 T6,

D. Supporting system fastening method: Engineered aluminum fin plates, and clip, complying with the following.

1. Baguettes/louvers with internal aluminum spline and gasket fastened to fin plates.
2. The aluminum fin plate is fastened to the building structural system as shown on the Construction Documents or Installation Contractor’s Shop Drawings.
3. The replacement of damaged baguettes/louvers, particularly in the field, must be possible using simple methods and shall not require special tools nor damage the surrounding baguettes/louvers.
4. Gaskets shall be colored black, unless specified by the Architect to match the baguette/louver color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Terra cotta baguette/louver installer to examine conditions affecting the work of this Section at site. If any conditions exist that would be detrimental to proper installation of terra cotta baguette/louver system, installer is to notify Architect and General Contractor / Construction Manager in writing.

B. Correct conditions detrimental to the proper and timely completion of this work before proceeding with installation.

3.2 INSTALLATION

A. Do not install broken, chipped or cracked baguettes/louvers.

B. Apply coat of bituminous paint on concealed aluminum surfaces to be in contact with steel, cementitious, and dissimilar materials.

C. Install terra cotta baguettes/louvers to supporting system specified in accordance with the approved shop drawings and their manufacturer's instructions.

D. Conceal fasteners.

E. Ensure that assembly is plumb, level and free of warp or twist; maintain dimensional tolerances and alignment with adjacent work.

1. Use caution to prevent damage to terra cotta baguettes/louvers.
2. When field-cutting, use caution to ensure that cuttings do not remain on exposed surfaces. Cut edges shall be sharp, without spalling.
3. Cutting shall be performed with a diamond tipped wet saw.

F. Built-in work:

1. As work progresses, build in accessories and other items.
2. Where applicable, remove protective film from finished aluminum surfaces.

G. Tolerances: Accurately align and locate components to column lines and floor levels; adjust work to conform to the following tolerances.

1. Plumb: 1/8-inch in 10 feet; 1/4-inch in 40 feet; non-cumulative.
2. Level: 1/8-inch in 20 feet; 1/4-inch in 40 feet; non-cumulative.
3. Alignment: Limit offset to 1/16-inch where surfaces are flush or less than 1/2-inch out of flush, and separated by less than 2 inches (by reveal or protruding work); otherwise limit offsets to 1/8 inch.
4. Location: 3/8-inch maximum deviation from measured theoretical location (any member, and location).
5. Lipping between units: 1/16 inch maximum.
6. Finished work shall be viewed from a distance of 15 feet per ASTM C216-07a.

3.3 CLEANING

A. Clean soiled surfaces using materials which will not harm terra cotta baguettes/louvers or adjacent materials, as recommended by the terra cotta baguette/louver manufacturer (clean with mild detergent using a natural bristle brush, starting from top of building to the bottom). Use non-metallic tools in cleaning operations. Pressure washer not to exceed 1200 psi.

B. Upon completion of installation, remove protective coatings or coverings and clean aluminum surfaces, exercising care to avoid damage of finish.

C. Remove excess sealant compounds, dirt or other foreign substances.

D. Remove and replace terra cotta baguettes/louvers that are broken, chipped, cracked, abraded or damaged during construction period. Reinstall in accordance with their manufacturer's instructions.

END OF SECTION

SECTION 07 5419 - THERMOPLASTIC POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered PVC membrane roofing system.
2. Vapor retarder.
3. Roof insulation.
4. Section includes the installation of acoustical roof deck rib insulation strips furnished under Division 05 Section "Steel Decking."

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
3. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter-flashings.
4. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 based on criteria indicated in structural drawings.

D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-90.

2. Hail Resistance: MH.

E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

F. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low -slope roof products.

G. Energy Performance: Provide roofing system with initial solar reflectance not less than .0.83 and emissivity not less than 0.90 when tested according to CRRC-1.

1.5 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product indicated.

C. LEED Submittals:

1. Product Data for Credit SS 7.2: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.

2. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.

3. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants used inside the weatherproofing system, documentation indicating that they comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Base flashings and membrane terminations.

2. Tapered insulation, including slopes.

3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing, fastening spacings and patterns for mechanically fastened membrane roofing.

4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
5. Minimum Scale of Details: 6"=1'-0".

1.6 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation fasteners for membrane roofing system as approved by membrane roofing manufacturer and testing.

D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

G. Pre-installation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

H. Provide the following upon request:

1. Qualification Data: For qualified Installer and manufacturer.
2. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   a. Submit evidence of compliance with performance requirements.
3. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
4. Field quality-control reports.

1.9 MOCKUP

A. Site Mockups: Build mockups to demonstrate installation meets specified quality standards.

1. Furnish all labor and materials to completely install mockup.
2. Schedule mockup sufficiently in advance to cause no delay.

3. Mockup shall have all details complete and identical to those approved on the shop drawings. Mockup shall demonstrate quality of materials, finish, and workmanship, as well as compliance with performance requirements.

4. Provide schedule for mockup a minimum of 14 days in advance of installation to permit owner and Architect to coordinate monitoring and observation.

5. Mockup size: as indicated.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.11 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty includes roofing assembly from top of substrate deck to top of roofing including all components such as vapor retarders, fasteners, adhesives, roofing membrane, ballast, seals and sealants, flashing and venting.

B. Warranty shall be written on form at the end of this Section.

C. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PVC MEMBRANE ROOFING

A. PVC Sheet: ASTM D 4434, Type II, Grade I, glass fiber reinforced, felt backed.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Sarnafil Inc.; Sarnafil G410.
2. Thickness: 60 mils, minimum.
3. Exposed Face Color: White.

B. PVC Sheet: ASTM D 4434, Type III, fabric reinforced .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Carlisle SynTec, Incorporated; Sure-Flex Kee HP.
   b. Johns Manville; JM PVC.
2. Thickness: 60 mils, minimum .
3. Exposed Face Color: EnergySmart White.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
?. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.

C. PVC coated metal: Manufacturer's PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. 24 gauge, G90 galvanized metal sheet with a 20 mil PVC membrane laminated on one side.

D. Bonding Adhesive: Manufacturer's standard.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors spacing of 9" on center minimum unless otherwise required by the manufacturer. Provide galvanized sheet metal backup plate at locations where adequate substrate is not available for securing the termination bar.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings,

preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

H. Reinforced Fluid Applied Flashing:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Soprema; Alsan RS 230 Flash system.

2.3 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Georgia-Pacific Corporation; Dens Deck.
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. USG Corporation; Securock.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.4 VAPOR RETARDER

A. Concrete Deck Applications:

1. 2 ply Built-up Asphalt Roof
   a. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt impregnated .
   b. Roofing Asphalt: ASTM D 312, Type III or Type IV.
   c. Asphalt Primer: ASTM D 41.
2. SBS Modified Bitumen: Basis of Design Product: Soprema; Sopralene 180SP, Torch-Applied.

B. Metal Deck Applications:

1. Self-Adhering-Sheet Vapor Retarder: Polyethylene film laminated to layer of SBS modified bituminous adhesive, minimum 32-mil- total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC membrane roofing manufacturer, of thicknesses indicated and that produce FM Approvals-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2, coated glass-fiber mat facer on both major surfaces.

1. Board Size: 4'-0" x 4'-0"
2. Thickness: Two layers minimum, of total thickness required to provide a minimum aged thermal resistance of R30 (deg. F.h.sf/Btu).

C. Tapered Insulation: ASTM C 1289, Type II, Class 2, Grade 2, coated glass-fiber mat facer on both major surfaces. Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated. ASTM C 1289, Type II, Class 2, Grade 2, coated glass-fiber mat facer on both major surfaces.

2.6 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multi-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

D. Sprayed Polyurethane Foam: One- or two-component, foamed-in-place, closed cell polyurethane foam, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam manufacturer.

E. Cover Board: ASTM C 1177, glass-mat, water-resistant gypsum substrate, 1/4 inch thick , factory primed.

1. Board Size: 8'-0" x 4'-0".
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Georgia-Pacific Corporation; Dens Deck Prime.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."

4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.

5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

D. Install acoustical roof deck rib insulation strips, specified in Division 05 Section "Steel Decking," according to acoustical roof deck manufacturer's written instructions, immediately before installation of overlying construction and to remain dry.

3.3 SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.4 VAPOR-RETARDER INSTALLATION

A. Metal Roof Deck/Substrate Board Application:

1. Self-Adhered Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.

B. Concrete Roof Deck Application:

1. SBS Modified Bitumen:
   a. Torch apply 1 ply of SBS modified bitumen vapor retarder according to manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
2. Built-up Vapor Retarder:
   a. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. or as required by manufacturer and allow primer to dry.
   b. Install two glass-fiber felt plies lapping each felt 19 inches over preceding felt.
   c. Embed each felt in a solid mopping of hot roofing asphalt.
   d. Glaze-coat completed surface with hot roofing asphalt.
   e. Apply hot roofing asphalt within plus or minus 25 deg F of equiviscous temperature.

C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

D. Provide an air tight transition to the wall air barrier.

3.5 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does

not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

2. Fill gaps exceeding 1/4 inch with spray foam insulation.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Set in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining the coverboard in place.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

1. Install sheet according to ASTM D 5036.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.

2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.

3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Periodic Inspections: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation weekly during periods of ongoing installation.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

D. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

Roofing Special Warranty Form follows
Project Title:
Project Address:
Architect's Project No. Contractor's Job Number:
Warranted Work (and location description if less than full roof):

Specification Section No. and Title:
Length of Warranty: years
The undersigned herewith warrant that the above stated Work has been executed in conformance with the requirements of the Contract Documents for the Project named and warrant said Work to perform as specified and without failure for the above stated period of time,
starting on , 20 ___, and ending on , 20___.
This warranty does not apply to failure to perform due to abuse or neglect by the Owner, or the Owner's successor in interest, or damage by vandalism.

Contractor (the entity holding direct contract with Owner)	Firm
	Representative*
	Signed
	Title
	Notary
	Date
Roofing Installer Same as Contractor (if same as Contractor, check box; leave linesblank)	Firm
	Representative*
	Signed
	Title
	Notary
	Date
Roofing Membrane	Firm
	Representative*

Manufacturer	
	Signed
	Title
	Notary
	Date

*The Firm's Representative affirms they are authorized to bind the Firm to this Warranty.
END OF SPECIAL WARRANTY FORM

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manufactured through-wall flashing with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockup".
2. Section 06 1053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches .

D. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

B. Provide the following upon request:

1. Qualification Data: For fabricator.
2. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
3. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. FM Approvals Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

E. SPRI Wind Design Standard: Manufacture and install [**copings**] [**roof edge flashings**] tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.

1. Nonpatinated Exposed Finish: Mill.

C. Aluminum Sheet: ASTM B 209 , alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil .

2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil .

D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: 2D (dull, cold rolled).

E. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Smooth, flat and mill phosphatized for field painting.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil .

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft.minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured itemunless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal[or manufactured item].

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.

b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.

3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Solder:

1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

2. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

3. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric [polyurethane] [polysulfide] [silicone] polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

   a. Fry Reglet Corporation.

   b. Heckmann Building Products, Inc.

   c. Hohmann & Barnard, Inc.

3. Material: Galvanized steel, 0.022 inch thick.

4. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.

6. Accessories:

   a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.

   b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

7. Finish: With manufacturer's standard color coating.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

2. Obtain field measurements for accurate fit before shop fabrication.

3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

K. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.

B. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches . Roll laps and edges with roller. Cover underlayment within 14 days.

B. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.

5. Torch cutting of sheet metal flashing and trim is not permitted.

6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches ; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.

2. Do not use torches for soldering.

3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and solder to scupper.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

D. Cap Flashing/Counterflashing:

1. Coordinate installation of counterflashing with installation of base flashing.
2. Install metal cap flashing over composition base flashing which turns up into vertical surfaces.
3. In new masonry work, set flashing in a bed of mortar both above and below the metal.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 7100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copings.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 06 1053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 07 4113.13 "Formed Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
4. Section 07 6200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
5. Section 07 7200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
6. Section 07 9200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

D. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

E. Samples: For each type of roof specialty and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

B. Provide the following upon request:

1. Qualification Data: For manufacturer.
2. Product Certificates: For each type of roof specialty.
3. Product Test Reports: For copings, for tests performed by a qualified testing agency.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge as shown on Drawings.
2. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 01 4000 "Quality Requirements"
3. Build mockup of typical roof edge, including fascia gutter and downspout, approximately 10 feet long, including supporting construction, seams, attachments, underlayment, and accessories.

4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
6. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   a. Cheney Flashing Company.
   b. Hickman Company, W. P.
   c. Metal-Era, Inc.
   d. Petersen Aluminum Corporation.

3. Metallic-Coated Steel Sheet Coping Caps: Zinc-coated (galvanized) steel, nominal thickness as required to meet performance requirements.
   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

4. Corners: Factory mitered and soldered.

5. Coping-Cap Attachment Method: face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.
   a. Face-Leg Cleats: Concealed, continuous stainless steel.

2.3 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

B. Aluminum Sheet: ASTM B 209 , alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Carlisle Coatings & Waterproofing Inc; CCW WIP 300HT.
   b. Grace Construction Products; W.R. Grace & Co. -- Conn.; Grace Ice and Water Shield HT.
   c. Henry Company; Blueskin PE200 HT.
2. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
3. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.

B. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Galvanized-Steel Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.

a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches . Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under copings.

2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches .

3.3 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches ; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.4 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7100

SECTION 07 7200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Preformed flashing sleeves.

B. Related Sections:

1. Section 07 6200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
2. Section 07 7100 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

D. Delegated-Design Submittal: For roof curbs equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.

2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.

2. Method of attaching roof accessories to roof or building structure.

3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: As indicated on Drawings.

2.2 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, 0.064 inch thick.

1. Finish: Factory prime coating.

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
4. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
5. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
7. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
8. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.

9. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.

10. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed structure-mounting flange at bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, 0.064 inch thick.

1. Finish: Factory prime coating.

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.

2. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.

3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.

4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches wide on top flange of equipment supports, continuous around support perimeter.

5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.

6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.

7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.

8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.

9. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.

10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.4 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated single -walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Nystrom, Inc. Thermal Max Roof Hatch or comparable product by one of the following:
   a. Acudor Products, Inc.
   b. AES Industries, Inc.
   c. Babcock-Davis.
   d. Bilco Company (The).
   e. Bristolite Skylights.
   f. Custom Solution Roof and Metal Products.
   g. Dur-Red Products.
   h. JL Industries, Inc.; a division of the Activar Construction Products Group.
   i. KCC International Inc.
   j. Lexcor; a division of Luxsuco corp.
   k. Metallic Products Corp.
   l. Milcor; Commercial Products Group of Hart & Cooley, Inc.
   m. Nystrom, Inc.
   n. O'Keeffe's Inc.
   o. Williams Brothers Corporation of America.

B. Type and Size: Single-leaf lid, 48 by 48 inches.

C. Hatch Material: Aluminum sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Mill

D. Construction:

1. Insulation: [Polyisocyanurate board].

E. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
3. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.

4. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.

2.5 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted metal collar.

1. Metal: Aluminum sheet, 0.063 inch thick.
2. Diameter: As indicated on Drawings.
3. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

1. Metal: Aluminum sheet, 0.063 inch thick.
2. Height: 13 inches.
3. Diameter: As indicated on Drawings.
4. Finish: Manufacturer's standard.

2.6 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation[and mill phosphatized for field painting where indicated].

1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.

B. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

2.7 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Underlayment:

1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

2. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

3. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C 920, elastomeric [polyurethane] [silicone] polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.

2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.

3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.

4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

1. Attach curbs to wood nailer on roof deck with wood screws.

2. Weld curbs to metal roof deck.

3. Bolt curbs to concrete roof deck with lead shield expansion type inserts through each pre-drilled hole with 3/8 inchcorrosion resistant steel bolts.

4. Anchor counter-flashing to wood nailer with lag screws and lead washers.

D. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

E. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Clean off excess sealants.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 8100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes sprayed fire-resistive materials.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For paints and coatings, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.

2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.

3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of

each structural component and assembly.

4. Treatment of fireproofing after application.

E. Samples: For each exposed product and for each color and texture specified, 4 inches square in size.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

B. Provide the following upon request:

1. Qualification Data: For Installer and testing agency.
2. Product Certificates: For each type of fireproofing.
3. Evaluation Reports: For fireproofing, from ICC-ES.
4. Preconstruction Test Reports: For fireproofing.
5. Field quality-control reports.
6. Application Certificate: Submit Applicator's certificate addressed to the fire safety authority having jurisdiction over the Project, stating that materials have been applied in accordance with the Contract Documents.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on fireproofing.

1. Provide test specimens and assemblies representative of proposed materials and construction.

B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.

1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

C. Low-Emitting Materials: Fireproofing used within the weatherproofing system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Standard Density Sprayed Fire-Resistive Material : Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Grace Construction Products; W.R. Grace & Co. -- Conn.; Grace Construction Products; Monokote MK-6 Series.
   b. Isolatek International; Cafco 300.
2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
3. Bond Strength: Minimum 430-lbf/sq. ft. cohesive and adhesive strength based on field testing according to ASTM E 736.
4. Density: Not less than 15 lb/cu. ft. as specified in the approved fire-resistance design,

according to ASTM E605.

5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch .
6. Combustion Characteristics: ASTM E 136.
7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 10 or less.
   b. Smoke-Developed Index: 10 or less.
8. Compressive Strength: Minimum 100 lbf/sq. in. according to ASTM E 761.
9. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
10. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
12. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours according to ASTM E 859.
13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.
14. Finish: Spray-textured finish .

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.

C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.

2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.

3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Verify that concrete work on steel deck is complete before beginning fireproofing work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.

D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.

2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Metal Decks:

1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.

2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

G. Extend fireproofing in full thickness over entire area of each substrate to be protected.

H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

I. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.

J. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special

inspections:

1. Test and inspect as required by the CBC, Subsection 1704.10

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.

2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

SECTION 07 8413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For penetration firestopping sealants and sealant primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For penetration firestopping sealants and sealant primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Installation Responsibility: Assign installation of penetration firestopping and fire-resistive joint systems to a single qualified firestop contractor.

D. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.

b. Classification markings on penetration firestopping correspond to designations listed by the following:

1) UL in its "Fire Resistance Directory."

2) Intertek ETL SEMKO in its "Directory of Listed Building Products."

3) FM Global in its "Building Materials Approval Guide."

E. Preinstallation Conference: Conduct conference at Project site.

F. Provide the following upon request:

1. Qualification Data: For qualified Installer.

2. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.1 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Fire-resistance-rated walls include fire walls fire-barrier walls smoke-barrier walls and fire partitions.

2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Horizontal assemblies include floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.

2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.

3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

H. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

I. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-wool-fiber or rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.2 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.3 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

END OF SECTION

SECTION 07 8443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints at exterior curtain-wall/floor intersections.
3. Joints in smoke barriers.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 07 8413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
3. Section 09 2216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

B. Provide the following upon request:

1. Qualification Data: For Installer.

2. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

C. Comply with requirements of Sections 01 4339 "Exterior Mockups".

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.

1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg .

1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.

E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.

2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.

2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.

3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under product category Expansion/Seismic Joints or Firestop Systems.

END OF SECTION

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Preformed joint sealants.
5. Acoustical joint sealants.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 07 8443 "Joint Firestopping" for sealing joints in fire-resistance-rated construction.
3. Section 08 8000 "Glazing" for glazing sealants.
4. Section 09 2900 "Gypsum Board" for sealing perimeter joints.
5. Section 09 3000 "Tiling" for sealing tile joints.
6. Section 09 5113 "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.

2. Conduct field tests for each application indicated below:

a. Each kind of sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.

4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each joint-sealant product indicated.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For sealants and sealant primers used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

B. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

C. Field-Adhesion Test Reports: For each sealant application tested.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Provide the following upon request:

1. Qualification Data: For qualified Installer and testing agency.
2. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

3. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
4. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

E. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1. See Section 01 4339 "Exterior Walls Mockups".

F. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period:
   a. Polyurethane Sealants: One year from date of Substantial Completion.
   b. Silicone Sealants: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period:
   a. Polyurethane Sealants: 5 year from date of Substantial Completion.
2. Silicone Sealants: 20 years from date of Substantial Completion.2

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

E. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

F. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

G. Colors of Exposed Joint Sealants: As selected by University Representative from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Sealant JS-S1 - Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C

920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, provide products from the following table that has a validation certificate from the Sealant, Waterproofing and Restoration Institute (SWRI).

Manufacturer	Product	Manufacturer Rated Movement Capability (CLASS)
Dow Corning	756 SMS	± 50%
Dow Corning	795	± 50%
Momentive Performance Materials, Inc.	Silpruf NB SCS 9000	± 50%
Pecora Corporation	864	± 50%
Pecora Corporation	895	± 50%
Tremco Incorporated	Spectrum 3	± 50%

B. Sealant JS-S2 - Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, provide products from the following table that has a validation certificate from the Sealant, Waterproofing and Restoration Institute (SWRI).

			Substrate Primer Required: Yes/No/Test			
Manufacturer	Product	Manufacturer Rated Movement Capability [CLASS]	Mortar *	Anod. Alum.	Uncoated Glass	Other**
Dow Corning	790	+ 100/- 50%	No	Yes	No	Test
Momentive Performance Materials, Inc.	Silpruf LM SCS2700	+ 100/- 50%	Yes	Test	No	Test
Pecora Corporation	890	+ 100/- 50%	Yes	Test	No	Test

Manufacturer	Product	Substrate Primer Required: Yes/No/Test				
		Manufacturer Rated Movement Capability [CLASS]	Mortar *	Anod. Alum.	Uncoated Glass	Other**
Tremco Incorporated	Spectrum 1	+ 100/- 50%	Yes	Test	No	

|Table Notes:
|* Indicates substrates with a cement component, such as concrete, that require use of a primer.
|** Indicates that other substrates shall be tested for adhesion to determine if a primer will be required.

2.3 WEATHER BARRIER SEALANTS

A. Sealant JS-W1 - Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT; tested and marketed specifically for sealing air barrier and vapor retarder sheets to common building materials, such as aluminum, vinyl, PVC, powder coat, paint and fluoropolymer coatings; UV resistant..

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Corning Corporation; 758.

2.4 URETHANE JOINT SEALANTS

A. Sealant JS-U1 - Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920. Type M, Grade P, Class 25, for Use T and I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tremco Incorporated; Vulkem 445SSL.
   b. Sika; Sikaflex 2C-SL

2.5 LATEX JOINT SEALANTS

A. Sealant JS-L1 - Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Bostik, Inc.; Chem-Calk 600.
   b. Pecora Corporation; AC-20 + Silicone.
   c. Tremco Incorporated; Tremflex 834.

2.6 BUTYL RUBBER BASED JOINT SEALANTS

A. Sealant JS-B1 - Butyl-Rubber-Based Joint Sealant: ASTM C 1311.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Bostik, Inc.; Chem-Calk 300.

b. Pecora Corporation; BC-158.

c. Tremco Incorporated; Tremco Butyl Sealant.

2.7 MILDEW-RESISTANT JOINT SEALANTS

A. Sealant JS-M1 - Mildew-Resistant, Single-Component, Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 786 Mildew Resistant.

b. GE Advanced Materials - Silicones; Sanitary SCS1700.

c. Pecora Corporation; 898.

d. Tremco Incorporated; Tremsil 200 Sanitary.

2.8 ACOUSTICAL JOINT SEALANTS

A. Sealant JS-A1 - Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. GE Construction Sealants; RCS20 Acousticsl.

b. Pecora Corporation; AC-20 FTR.

c. Tremco, Incorporated; Tremco Acoustical Sealant.

d. USG Corporation; SHEETROCK Acoustical Sealant.

2.9 PREFORMED JOINT SEALANTS

A. Sealant JS-P1 - Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 123 Silicone Seal.

b. GE Construction Sealants; UltraSpan US1100.

c. Tremco Incorporated; Spectrem Simple Seal.

B. Sealant JS-P2 - Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. EMSEAL Joint Systems, Ltd.; Seismic ColorSeal.
b. Balco Inc.; BCSW

2.10 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.11 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Do not extend exterior sealants and primers into building interior (that is, inside the weatherproofing system) unless first verifying compliance with VOC requirements.

D. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces. Water-based tooling agents are unacceptable.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

J. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
   a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated

requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces; Type JS-U1 and.

1. Joint Locations:
    a. Isolation and contraction joints in cast-in-place concrete slabs.
    b. Joints between plant-precast architectural concrete paving units.
    c. Tile control and expansion joints.
    d. Joints between different materials listed above.
    e. Other joints as indicated.
2. Joint-Sealant Color: As selected by University Representative from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces; Type JS-S1 JS-S2.

1. Joint Locations:
    a. Construction joints in cast-in-place concrete.
    b. Joints between plant-precast architectural concrete units.
    c. Control and expansion joints in unit masonry.
    d. Joints between metal panels.
    e. Joints between different materials listed above.
    f. Perimeter joints between materials listed above and frames of doors windowsand louvers.
    g. Control and expansion joints in ceilings and other overhead surfaces.
    h. Other joints as indicated.
2. Joint-Sealant Color: As selected by University Representative from manufacturer's full range of colors.

C. Joint-Sealant Application: Exterior weather barrier joints; Type JS-W1.

D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces; Type JS-U1.

1. Joint Locations:
   a. Isolation joints in cast-in-place concrete slabs.
   b. Control and expansion joints in stone flooring.
   c. Control and expansion joints in tile flooring.
   d. Other joints as indicated.
2. Joint-Sealant Color: As selected by University Representative from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces; Type JS-L1.

1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.
   d. Vertical joints on exposed surfaces of concrete wallsand partitions.
   e. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
   f. Other joints as indicated.
2. Joint-Sealant Color: As selected by University Representative from manufacturer's full range of colors.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces; Type JS-M1.

1. Joint Sealant Location:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Other joints as indicated.
2. Joint-Sealant Color: As selected by University Representative from manufacturer's full range of colors.

G. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces; Type JS-A1.

1. Joint Location:
   a. Acoustical joints where indicated.
   b. Other joints as indicated.
2. Joint-Sealant Color: As selected by University Representative from manufacturer's full range.

END OF SECTION

SECTION 07 9513.16 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes exterior building expansion joint cover assemblies.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

C. Shop Drawings: For each expansion joint cover assembly.

1. Include project specific plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.

2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

D. Samples: For each exposed expansion joint cover assembly and for each color and texture specified, full width by 6 inches long in size.

E. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion joint cover assembly.

2. Expansion joint cover assembly location cross-referenced to Drawings.

3. Nominal, minimum, and maximum joint width.

4. Movement direction.

5. Materials, colors, and finishes.

6. Product options.

7. Fire-resistance ratings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical expansion joint cover assembly as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
4. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 by a qualified testing agency.

1. Hose Stream Test: Wall-to-wall and wall-to-soffit assemblies shall be subjected to hose stream testing.

C. Expansion Joint Design Criteria <Insert drawing designation>:

1. Type of Movement: Seismic.
   a. Joint Movement: As indicated on Drawings.

2.3 EXTERIOR EXPANSION JOINT COVERS

A. Exterior Metal-Plate Joint Cover : Assembly consisting of sliding metal cover plate in continuous contact with gaskets mounted on metal frames fixed to sides of joint gap.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
    a. Balco, Inc.
    b. Construction Specialties, Inc.
    c. InPro Corporation (IPC).
    d. MM Systems Corporation.
    e. Nystrom, Inc.
    f. Watson Bowman Acme Corp.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Exposed Metal:
    a. Aluminum: Clear anodic, Class I.

B. Exterior Elastomeric-Seal Joint Cover : Assembly consisting of elastomeric seal anchored to surface-mounted frames fixed to sides of joint gap.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Balco Inc.; Rizza EV or comparable product by one of the following:
    a. Construction Specialties, Inc.
    b. MM Systems Corporation.
    c. Watson Bowman Acme Corp.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Exposed Metal:
    a. Aluminum: Clear anodic, Class I.
5. Seal: Preformed elastomeric membrane or extrusion.
    a. Material: Pre-cured Silicone.
    b. Color: As selected by Architect from manufacturer's full range.

2.4 MATERIALS

A. Aluminum: ASTM B 221 , Alloy 6063-T5 for extrusions; ASTM B 209 , Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.

D. Moisture Barrier: Manufacturer's standard, flexible pre-cured silicone elastomeric material.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.6 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.

1. Provide where indicated on Drawings.

B. Manufacturer's stainless-steel attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Install frames in continuous contact with adjacent surfaces.
    a. Shimming is not permitted.
5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

G. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.

3.4 CONNECTIONS

A. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with roof expansion joint covers specified in Section 07 7129 "Manufactured Roof Expansion Joints." Install factory-fabricated units at transition between exterior walls and soffits and roof expansion joint cover assemblies.

3.5 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections.

END OF SECTION

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 8 by 10 inches to demonstrate compliance with requirements for quality of materials and construction:
   a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
   b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

E. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 QUALITY ASSURANCE

A. Provide the following upon request.

1. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.053 inch.
    d. Edge Construction: Model 1, Full Flush.
    e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
3. Frames:
    a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch.
    b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: Full profile welded.
4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Maximum-Duty Doors and Frames: SDI A250.8, Level 4. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches
    c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
    d. Edge Construction: Model 1, Full Flush.
    e. Core: Polyisocyanurate.
        1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
3. Frames:
    a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
    b. Construction: Full profile welded.
4. Exposed Finish: Prime.

2.5 BORROWED LITES

A. Hollow-metal frames of uncoated steel sheet, minimum thickness of 0.053 inch.

B. Construction: Full profile welded.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.7 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 08 8000 "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.8 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.

2. Fire Door Cores: As required to provide fire-protection ratings indicated.

3. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.

4. Top Edge Closures: Close top edges of doors with flush closuresof same material as face sheets.

5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.

5. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:

1) Two anchors per jamb up to 60 inches high.
2) Three anchors per jamb from 60 to 90 inches high.
3) Four anchors per jamb from 90 to 120 inches high.
4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

c. Compression Type: Not less than two anchors in each frame.

d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.

2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.

3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

4. Provide loose stops and moldings on inside of hollow-metal work.

5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.10 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.

2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
    a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
    d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 08 1216 - ALUMINUM FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior aluminum frames for installed in gypsum board partitions.

B. Related Sections:

1. Section 08 1416 "Flush Wood Doors" for wood doors installed in interior aluminum frames.
2. Section 08 4113 "Aluminum-Framed Entrances and Storefronts" for aluminum-framed glass doors installed in interior aluminum frames.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, fire-resistance rating, and finishes.

C. Shop Drawings: Include the following:

1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
2. Locations of reinforcements and preparations for hardware.
3. Details of each different wall-opening condition.
4. Details of anchorages, joints, field splices, and connections.
5. Details of accessories.
6. Details of moldings, removable stops, and glazing.
7. Details of conduits and preparations for power, signal, and control systems.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include similar Samples of seals, gaskets, and accessories involving color selection.

E. Samples for Verification: For interior aluminum frames, prepared on Samples of size indicated below:

1. Framing Member: 12 inches long.
2. Corner Fabrication: 12-by-12-inch- long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.

F. Schedule: For interior aluminum frames. Use same designations indicated on Drawings. Coordinate with door hardware schedule and glazing.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For interior aluminum frames to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain interior aluminum frames from single source from single manufacturer.

B. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

C. Smoke- and Draft-Control Assemblies: Where indicated, provide assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

D. Provide the following upon request:

1. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of interior aluminum frame.

E. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver interior aluminum frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic. Store interior aluminum frames under cover at Project site.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Aluminum Framing: ASTM B 221, Alloy 6063-T5 or alloy and temper required to suit structural and finish requirements, not less than 0.062 inch thick.

B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

C. Glazing Frames: Extruded aluminum, for glazing thickness indicated.

D. Ceiling Tracks: Extruded aluminum.

E. Trim: Extruded aluminum, not less than 0.062 inch thick, with removable snap-in casing trim glazing stops and door stops without exposed fasteners.

2.2 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals.

C. Smoke Seals: Intumescent strip or fire-rated gaskets.

D. Glazing Gaskets: Manufacturer's standard extruded or molded plastic, to accommodate glazing thickness indicated.

E. Glazing: Comply with requirements in Section 08 8000 "Glazing."

F. Hardware: Comply with requirements in Section 08 7100 "Door Hardware"

2.3 FABRICATION

A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted or mitered connections.

B. Factory prepare interior aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 08 7100 "Door Hardware."

1. Locate hardware as required by fire-rated label for assembly.

C. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.

1. Locate removable stops on the inside of spaces accessed by keyed doors.

D. Fabricate components to allow secure installation without exposed fasteners.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and ceilings, with Installer present, for conditions affecting performance of the Work.

B. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install interior aluminum frames plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.

B. Set frames accurately in position and plumbed, aligned, and securely anchored to substrates.

1. At fire-protection-rated openings, install interior aluminum frames according to NFPA 80 and NFPA 105.

C. Install frame components in the longest possible lengths; components up to 96 inches long must be one piece.

1. Fasten to suspended ceiling grid on maximum 48-inch centers, using sheet metal screws or other fasteners approved by frame manufacturer.
2. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
3. Secure clips to extruded main-frame components and not to snap-in or trim members.
4. Do not leave screws or other fasteners exposed to view when installation is complete.

3.3 CLEANING

A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended by frame manufacturer and according to AAMA 609 & 610.

B. Touch up marred frame surfaces so touchup is not visible from a distance of 48 inches. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-core doorsand transom panels with wood-veneer and MDO faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 08 8000 "Glazing" for glass view panels in flush wood doors.
2. Section 09 9123 "Interior Painting" for field finishing doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction , louvers, and trim for openings. Include factory-finishing specifications.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
    a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.

3. Certificates for Credit MR 7: Chain-of-custody certificates indicating that flush wood doors comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
4. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
5. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
6. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
    a. Provide Samples for each species of veneer and solid lumber required.
    b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
3. Louver blade and frame sections, 6 inches (150 mm) long, for each material and finish specified.

4. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door ontop and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY

A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Lambton Doors.
4. Marshfield Door Systems, Inc.
5. VT Industries, Inc.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. Certified Wood: Flush wood doors shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

C. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

D. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

F. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.

3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
4. Pairs: Provide formed-steel edges and astragals with intumescent seals.
   a. Finish steel edges and astragals with baked enamelsame color as doors.

G. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

H. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2, made with binder containing no urea-formaldehyde.
2. Particleboard: Straw-based particleboard complying with ANSI A208.1, Grade LD-2 or M-2, except for density.
3. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
4. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

I. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
   a. Screw Withdrawal, Face: 700 lbf.
   b. Screw Withdrawal, Edge: 400 lbf.

J. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated asneeded to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
   a. Screw-Holding Capability: 475 lbf per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors :

1. Grade: Custom (Grade A faces).
2. Match between Veneer Leaves: **Book match.**
3. Assembly of Veneer Leaves on Door Faces: Balance match.

4. Pair and Set Match: Provide for doors hung in same openingor separated only by mullions.
5. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
6. Exposed Verticaland Top Edges: Same species as faces or a compatible species - edge Type A.
7. Core: Particleboard Structural composite lumber.
8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
9. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors :

1. Grade: Premium.
2. Faces: MDO Hardboard or MDF.
   a. Apply MDO to directly to high-density hardboard crossbands.
   b. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
3. Exposed Verticaland Top Edges: Any closed-grain hardwood.
4. Core: Particleboard Structural composite lumber.
5. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
6. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.5 LIGHT FRAMES AND LOUVERS

A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.

B. Metal Louvers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Air Louvers, Inc.
   b. Anemostat; a Mestek company.
   c. L & L Louvers, Inc.
   d. Louvers & Dampers, Inc.; a division of Mestek, Inc.
   e. McGill Architectural Products.
2. Blade Type: Vision-proof, inverted V.

3. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

C. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Air Louvers Inc.
   b. Anemostat; a Mestek company.
   c. L & L Louvers, Inc.
   d. Louvers & Dampers, Inc.; a Mestek company.
   e. McGill Architectural Products.
2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

1. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 8000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.7 SHOP PRIMING

A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 09 9123" Interior Painting."

B. Doors for Transparent Finish: Shop prime faces and all four edges with stain (if required), other required pretreatments, and first coat of finish as specified in Section 09 9300 "Staining and Transparent Finishing." Seal edges of cutouts and mortises with first coat of finish.

2.8 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted ontop and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors that are indicated to receive transparent finish.

C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Transparent Finish:

1. Grade: Premium.
2. Finish: WDMA TR-4 conversion varnish or WDMA TR-6 catalyzed polyurethane.
3. Staining: Match Architect's sample.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 7100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.

2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 1613 - FIBERGLASS DOORS & FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish and install doors, frames of FRP composite construction in accordance with details and schedule shown on the project drawings and as specified herein. Door and frame products of aluminum, steel or wood constructions that use FRP face sheets are strictly excluded.

B. FRP is defined as ÓFiberglass Reinforced Polyester•

C. Related Requirements

1. Section 08 1400: Wood Doors
2. Section 08 7000: Hardware
3. Section 08 8000: Glazing

1.2 QUALITY ASSURANCE

A. Referenced Standards

1. American Society for Testing and Materials (ASTM)
2. Society of Automotive Engineers (SAE)
3. International Building Code, Plastics (Chapter 26)
4. UL 10b and UL 10c, NFPA 252 and UBC7-2

B. Experience: Manufacturer shall be ISO 9001 certified and been engaged in the manufacture of FRP door and frame systems for a minimum of five (5) years documented experience prior to the start of this work, and who has a history of successful production acceptable to the Architect.

C. Referenced Standard: Where labeled fire doors are required, Fiberglass Doors and frames shall be UL listed and shall be tested successfully to UL10B / UL10C standards.

D. Process: Certify that FRP doors are manufactured via press-molding technology.

E. Warranty: Provide written limited guarantee for FRP doors and frames as follows:

1. Fiberglass Fire Doors are guaranteed for 10 years against delamination due to corrosion from the specific chemical environment named at the time of purchase. Furthermore, products are inspected prior to shipment and guarantied against defective workmanship for a period of ten (10) years after the date of purchase.

1.3 SUBMITTALS

A. Product Data: Provide catalog cut of FRP door detailing internal construction and reinforcements, materials used and description of molding process.

B. Shop Drawings: To include the following specific information:

1. Specifications relating to FRP door thickness, resin type, core material, method of construction, finish color, type of glass and glazing, anchor systems, joint construction and complete warranty information.

2. Complete schedules or drawings of FRP doors and frames (and associated Builders Hardware) showing identifying mark numbers, door and frame types, typical elevations, nominal sizes, handing, actual dimensions and clearances, and required hardware preps and reinforcements.

3. Supporting reference drawings pertaining to frame mounting details, door light or louver installation, hardware locations, and factory hardware cutouts and reinforcements.

C. Color Samples: Provide a complete set of available finish colors from the manufacturer for color selection upon request.

D. Installation instructions: Include manufacturer¢s specific information describing procedures, sequence and required fasteners for frame and door installation.

E. Production of FRP doors and frames shall not proceed until final approval of submittals and all necessary manufacturing information is received from customer.

1.4 DELIVERY, STORAGE AND HANDLING

A. FRP doors and frames are to be delivered to jobsite in adequate crating with foam sheet separations between all components.

B. Upon receipt of shipment, remove and inspect the doors and frames for damage. Note any damage on the shipping papers prior to accepting. If there is any noted (visible or concealed) damage, notify manufacturer.

C. Handling and storage of the doors and frames after receipt is the responsibility/liability of the customer. It is recommended that the doors be stored indoors in a vertical position, clear of the floor, with blocking between the doors to permit air circulation between the doors and prevent damage to the door faces. Rain/water or condensation must not be allowed to collect or lay between stored doors. Do not wrap in plastic sheeting as it will promote condensation formation within. Permanent discoloration can result. Failure to comply with the receiving and reporting instructions shall void the Tiger Door warranty.

D. Use care in handling FRP doors and frames to prevent damage to factory finishes. Wear protective gloves and do not slide or drag doors or frames against one another.

PART 2 - PRODUCTS

2.1 Manufacturer

A. FRP Doors and Frames shall be as manufactured by Tiger Door, www.tigerdoor.com.

2.2 FRP DOORS

A. Fire Rated FRP Doors:

1. Design: FRP doors shall be of seamless press-molded construction. Laminated FRP face sheets shall be applied while wet and uncured to an internal door stile and rail subframe/core assembly and then press-molded under heat and pressure. The composite door panel must be integrally fused over its entire surface area, not just adhesive-bonded at perimeter stiles and rails. Doors shall remain under pressure during curing for flat, warp-free surfaces.

2. Core: For maximum rigidity and compressive strength a fire resistant mineral core shall be used. Molding pressure and resin gel time shall be sufficient to allow for penetration of resin into the cellular structure of the core to maximize shear and peel strengths at the skin/core interface and reduce the possibility of delamination. The mineral core is to be completely enclosed within the intumescent and FRP laminated edge perimeter.

3. Intumescent: Only Category A type door construction is permitted. All intumescents shall be molded into the door structure with a minimum of 1/8• thick perimeter FRP edge banding (prior to machining). Category B type door construction, with post applied and/or exposed edge intumescent components or products are not acceptable.

4. Faces: Door facings shall be 0.120• composite FRP sheet exterior grade, fiber reinforced plastic panel on interior and exterior faces. Colored pigment shall be maximum amount formulated with the resin. FRP face sheets shall be USDA acceptable, non-porous, with a maximum flame spread rating of 200, and smoke generated maximum of 450 degrees meeting Class C requirements per ASTM E84.

5. 5. Finish: The exposed FRP door faces shall have a 3-4 mils (wet) factory applied two-part aliphatic polyurethane fully cured coating of industrial urethane. Coating shall have a minimum hardness of H to 2H. Finish shall be a slightly textured semi-gloss to minimize the visual effects of wear and tear.

6. Astragals: Provide a heavy pultruded FRP angle astragal on the meeting stile edge of each inactive leaf of double door pairs.

7. Lights: Provision for door lights shall be performed during manufacture and shall not be attempted in the field. Cutouts are to be totally enclosed by internal high density fire resistant mineral core composite blocks incorporated into door subframe prior to press-molding and machining, the opening is completely fused to both door skins. Vision frames shall be a commercially available UL fire rated kit. Maximum glass size shall not exceed 1296 in2 for up to a 90 minute application.

8. Louvers: Provision for door louvers shall be performed during manufacture and shall not be attempted in the field. Cutouts are to be totally enclosed by internal high density fire resistant mineral core composite blocks incorporated into door subframe prior to

press-molding and machining, the opening is completely fused to both door skins. Door louvers shall be a commercially available UL fire rated kit. Maximum louver size shall not exceed 24• x 24• for up to a 90 minute application.

9. Size limitations: The maximum double door jamb opening size shall not exceed nominal 8¢ œ 0 x 8¢ œ 0 with a Maximum single door panel size not to exceed nominal 4¢ œ 0 x 8¢ œ 0 .

2.3 FRP FRAMES

A. Fire Rated Frames:

1. Design: Fire rated FRP Door frames furnished under this specification shall utilize a high-modulus pultruded structural FRP shape. Standard frame profile is a double rabbeted 5¾•depth x 2" face, 3/16• thick, with integral 5/8" doorstop. The minimum frame section shall be limited to a 4• jamb depth, 1• face. Four inch header and expanded profiles are acceptable. Frame cavities shall be filled with a proprietary fire resistant composite formulation. Hollow metal or Stainless Steel frames are not acceptable.

2. Intumescent: All intumescent material shall be internal to the door structure. Post applied or exposed intumescent components or products are not acceptable

3. Corner Joints: Jambs and headershall be joined at corners via miter connections with hidden stainless steel flat head screws. Corner screws shall not be visible on interior or exterior frame faces.

4. Anchors:

a. BOLT-IN: Provide manufacturer¢s required number of 3/8• diameter x 4• long flat head stainless steel sleeve anchors for masonry openings, 3/8• diameter x 4• machine screw with nut and washers for structural steel openings, #14 x 4• stainless steel flat head sheet metal screws for wood or steel stud openings. Include extra anchors for additional frame height in two foot increments above 8¢- 0• . Provide single bolt anchor at center of all headers over four feet in nominal width. Stainless Steel fasteners shall be furnished by the factory.

b. GROUT-IN: Provide manufacturer¢s required number of wire or strap type masonry anchors for installation into block wall. Fill frame cavity with grout.

5. Finish: Frames shall have a 3-4 mils (wet) factory applied two-part aliphatic polyurethane fully cured coating of industrial urethane. Industrial urethane chemical coating color topcoat, to match the color and sheen of the doors, for superior weatherability. Gelcoat may not be sprayed onto the frame as a secondary coating.

2.4 MECHANICAL PROPERTIES AND TEST PERFORMANCE

A. Pultruded structural shapes for edges, frames, and astragals shall exhibit the following minimum longitudinal coupon properties (per ASTM):

1. Tensile strength (D638) 30,000 psi

2. Comprehensive strength (D695) 30,000 psi

3. Flexural strength (D790) 30,000 psi

4. Flexural modulus (D790) 1,600,000 psi
5. Shear strength (D2846) 4,500 psi
6. Impact, notched (D256) 25 ft-lb/in
7. Barcol hardness (D2853) 50

B. Core material shall exhibit the following minimum properties:

1. Core material must comply with the International Building Code (IBC) chapter 26 requirements for use with a plastic skin.
2. Core material must be asbestos free incombustible mineral composition.

C. Core banding material shall exhibit the following minimum coupon properties (per ASTM):

1. Core banding material must comply with the International Building Code (IBC) chapter 26 requirements for use with a plastic skin.
2. Modulus of Rupture (C133) 1700 psi
3. Compressive Strength (C109-93) 2800 psi
4. Thermal Conductivity 946 F(C182) 1.38 (BTU-in/hr-ft2-F)
5. Thermal Conductivity 1632 F (C182) 1.39 (BTU-in/hr-ft2-F)
6. Shrinkage average % (C356) at 1200 F 24 hours -4.7%
7. Screw Holding 1100 lbs
8. Electrical Resistivity from ambient to 1148 F (D257) 3.40 E+10 ohm-cm
9. Heat Transfer for unexposed surface rise above ambient 90 minute, 1772 F (E 152) 196 F
10. Density minimum 60 lb/ft3
11. Core banding material must be asbestos free incombustible mineral composition.

D. Adhesive for bonding pultrusions shall exhibit the following minimum coupon properties (per SAE)

1. Tensile Strength (D882-83A modified) minimum 2000 psi
2. 8 day 25º C at 100% humidity Cross Peel (SAE J1553) minimum 330 psi
3. 7 day immersion in seawater Cross Peel (SAE J1553) minimum 330 psi
4. 30 day immersion in saltwater Cross Peel (SAE J1553) minimum 330 psi
5. 72 hour immersion in gasoline Cross Peel (SAE J1553) minimum 330 psi
6. 72 hour immersion in 20% sulfuric acid Cross Peel (SAE J1553) minimum 300 psi

E. UL 10b, UL 10c / UBC7-2 positive pressure œ Doors and Frames

1. Singles and pairs, with component listings for both FRP doors and FRP frames

F. UL 9, Fixed Sash

1. Listing for Fiberglass fixed sash with FRP glazing stop.

FASTENERS

G. All fasteners for all hardware shall be type 304 CRSS (18-8 series corrosion resistant stainless steel). No carbon steel or aluminum components shall be used.

2.5 HARDWARE

A. Doors shall be factory mortised and drilled for mortise template butt hinges, with #12x2• long stainless steel screws pre-installed for hinge attachment. Provide 161 cylindrical lock bore, rim deadbolt, ANSI 86 mortise lock edge prep and pocket or flush bolt cutouts as required.

B. Frames shall be factory machined and drilled for all hardware requiring mortises, with #12x1• long stainless steel screws pre-installed for hinge attachment.

C. Hardware shall be furnished as listed in section 08 7000 or as so designated in appropriate section, and shall be coordinated by GC and installed by experienced mechanics.

D. Supplier shall furnish manufacturer¢s standard templates, installation instructions, or full size approved door and frame preparation instructions as approved by the architect and as required by door and frame manufacturer prior to door and frame factory initiated manufacture. Standard factory lead-time for production of FRP doors and frames shall commence only and when all distributor required preparation information is received and acknowledged by the door and frame manufacturer.

PART 3 - EXECUTION

3.1 IDENTIFICATION

A. Factory mark all doors and frames using a chemical resistant plastic tag or indelible marker with identifying number, keyed to shop drawings, prior to shipment.

3.2 INSTALLATION

A. Frames: Install in strict accordance with manufacturer¢s printed instructions. Set plumb and square, using shims for bolt-in of existing openings, or wood bracing prior to grouting of jambs. Use at least two 2x6 wood spreaders inside frame to maintain critical opening dimensions during grouting.

B. Doors: Hang per manufacturer¢s printed instructions using special screws provided for hinge attachment. Install doors to swing freely and to stand open at any angle. After installation make final adjustments to hardware to allow for proper door operation and latching. All surface applied hardware shall be thru bolted.

3.3 CLEANING

A. Clean exposed surfaces of FRP doors and frames with a mild, non-abrasive cleaner and water.

END OF SECTION

SECTION 08 3113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges :

1. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
2. Locations: Wall and ceiling.
3. Stainless-Steel Sheet for Door: Nominal 0.062 inch , 16 gage, No. 4 finish.
4. Frame Material: Same material and thickness as door.
5. Latch and Lock: Cam latch, key operated.

B. <u>Recessed Access Doors with Concealed Flanges:</u>

1. Basis-of-Design Product**: Subject to compliance with requirements, provide Acudor AT-5020:**

2. **Description: Door face recessed** 1 inch **for brick veneer infill with concealed flange**

3. **Locations: Wall**

4. **Door Size: 24x36**

C. **GRG (Glassfiber Reinforced Gypsum) Flush Access Doors**

1. Manufacturers: Subject to compliance with requirements, provide Moonlight Molds GRG Square Corner Access Panel with trim ring. **Description: Face of panel flush with ceiling; frameless surface installation.**

2. **Locations: Ceiling**

3. **Panel Size: 24x24.**

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Concealed Flanges :

1. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
2. Locations: Wall and ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Stainless-Steel Sheet for Door: Nominal 0.038 inch , 20 gage, No. 4 finish.
5. Frame Material: Same material, thickness, and finish as door.
6. Latch and Lock: Self-closing, self-latching door hardware, operated by key.

2.4 MATERIALS

A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

B. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.5 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

2. Polished Finish: No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.

b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 08 3323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulated service doors[~~with integral pass doors~~.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for miscellaneous steel supports.
2. Section 09 9113 "Exterior Painting" for finish painting of factory-primed doors.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Show locations of controls, locking devices[, detectors or replaceable fusible links], and other accessories.

6. Include diagrams for power, signal, and control wiring.

D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.
2. Bottom bar with sensor edge.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Regulatory Requirements: Comply with applicable provisions in the 2010 ADA Standards and CBC11B .

C. Provide the following upon request:

1. Qualification Data: For Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.

2. Testing: According to ASTM E 330.

3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. wind load, acting inward and outward.

B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 DOOR ASSEMBLY

A. Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Cornell Ironworks, Inc. Thermiser Max Model ESD30 or comparable product by one of the following:

a. Cornell Iron Works, Inc.

b. Provene Doors: Therm-Master 600

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283.

D. Curtain R-Value: 5.0 deg F x h x sq. ft./Btu.

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.

1. Insulated-Slat Interior Facing: Metal.

2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Hood: Match curtain material and finish.

1. Shape: Round.

2. Mounting: Face of wall.

J. Locking Devices: Equip door with locking device assembly .

K. Manual Door Operator: Chain-hoist operator.

L. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Top of hood.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use[; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower].
4. Motor Exposure: Interior.
5. Emergency Manual Operation: Chain type.
6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
   a. Sensor Edge Bulb Color: Black.
7. Control Station(s): Where shown on Drawings.

M. Curtain Accessories: Equip door with weatherseals.

N. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face .

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain[, and a continuous bar for holding windlocks].

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.

2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene.

2.9 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

D. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.11 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.

2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

D. Motors: Reversible-type motor[with controller (disconnect switch)] for motor exposure indicated.

1. Electrical Characteristics:
   a. Phase: Single phase.
   b. Volts: 115 V.
   c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.

3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.13 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather-resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.

2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08 3483 - ELEVATOR DOOR SMOKE CONTAINMENT SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Smoke detector activated elevator door smoke containment screen and control system designed to provide a tight-fitting, smoke- and draft-control assembly.

B. Products Supplied But Not Installed Under This Section:

1. End-of-line diode (3.9V, 2W). Installed at smoke detector to monitor the circuit.

C. Related Requirements:

1. 09 2200-Non-Load Bearing Wall Framing: Metal backing in housing mounting area.
2. 09 9100-Paints: Field painting of specified components.
3. 14 2100-Electric Traction Elevators.
4. 14 2400-Hydraulic Elevators.
5. Division 26 Sections for 120VAC and control circuit power including conduit, boxes, conductors, wiring devices, and emergency power.
6. Division 28-Detection and Alarm: Provision of smoke detectors.

1.2 REFERENCES

A. ASTM A240/240M - Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

B. ICC Evaluation Service ES-AC77 - Acceptance Criteria for Smoke-Containment Systems Used With Fire-Resistive Elevator Hoistway Doors and Frames.

C. ICC Evaluation Service report ESR-1136

D. NFPA Codes and Standards:

1. 70 - National Electrical Code.
2. 105 - Recommended Practice for the Installation of Smoke-Control Door Assemblies.
3. 72 – National Fire Alarm Code

E. UL Standards:

1. 268 - Smoke Detectors for Fire Protective Signaling Systems.
2. 508 - Industrial Control Equipment.
3. 864 - Control Units for Fire Protective Signaling Systems.
4. 1784 - Air Leakage Tests for Door Assemblies.

1.3 SUBMITTALS

A. Reference Section 01 3330 - Submittal Procedures; submit following items:

1. Product Data.
2. Shop Drawings: Include door width and height, jamb width, jamb and head projection, screen width, mounting height, and housing width. Show and identify related work performed under other sections of the specifications.
3. Quality Assurance/Control Submittals:
   a. Qualifications:
      1) Proof of manufacturer qualifications.
      2) Proof of Installer qualifications.
   b. Certifications: Copy of specified items.
   c. Manufacturer's installation instructions and testing procedures

1.4 CLOSEOUT SUBMITTALS

A. Comply with Section 01 7700-Closeout Procedures; submit following items:

1. Operation and Maintenance Manual.
2. Manufacturer's Warranties

1.5 QUALITY ASSURANCE

A. Overall Standards:

1. Manufacturer shall maintain a quality control program in accordance with ICC-ES Acceptance Criteria 77.

B. Qualifications:

1. Manufacturer Qualifications: Minimum seven years experience in producing smoke containment systems of the type specified.
2. Installer Qualifications: Factory trained by manufacturer.

C. Certifications:

1. Manufacturer's ICC Evaluation Service report ESR-1136 showing compliance with:
   a. ICC-ES AC77
   b. UL standard 1784
   c. AST, E84
   d. NFPA 105
2. IAS Accredited Testing Laboratory Labels for UL Standard 1784
3. IAS Accredited Testing Laboratory Labels for UL Standard 864

D. Pre-Installation Meeting:

1. Schedule and convene a pre-installation meeting prior to commencement of field operations with representatives of the following in attendance: Owner, Architect, General Contractor, smoke containment system sub-contractor, painting sub-contractor, and electrical sub-contractor.
2. Review substrate conditions, requirements of related work, installation instructions, storage and handling procedures, and protection measures.
3. Keep minutes of meeting including responsibilities of various parties and deviations from specifications and installation instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 6000-Product Requirements.

B. Comply with manufacturer's instructions.

1.7 WARRANTY

A. Provide manufacturer's standard one year warranty.

B. Maintenance and Testing:

1. Perform minimum semi-annual maintenance and testing on each smoke containment system as required by the manufacturer's warranty, code agency evaluation reports, and as required by local authority having jurisdiction.
2. Provide test documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Model ~~200~~ 400

B. Manufacturer:

1. Smoke Guard, 287 Maple Grove, Boise, Idaho 83704 http://www.smokeguard.com/
2. Approved equal.

C. Label each smoke containment system with following information:

1. Manufacturer's name.
2. Maximum leakage rating at specified pressure and temperature conditions.
3. Label of quality control agency.

2.2 PERFORMANCE

A. Air Leakage: Not to exceed 3 cfm (0.001416 m^3/s) per sf of door opening at 0.1 in (25 Pa) water pressure differential at ambient temperature and 400 degrees F tested per IBC 2012.

2.3 COMPONENTS

A. Screen:

1. Film: Minimum 1 mil thick transparent polyimide film reinforced with minimum 100 denier Nomex yarn at .25 in (6.35 mm) each way.

2. Magnetic Strips: Flexible multi-pole strips attached to longitudinal edges of film with low modulus silicone adhesive.

B. Housing: 20 gage, powder coated, cold rolled steel container with dust cover and door with concealed hinges and a latch. Housings are 55 inches or 64 inches in length, plus 1-1/2 inches for a junction box on the left side.

C. Auxiliary Rails:

1. Material: 16 gage ASTM A 240/240M, Type 430, ferritic stainless steel.

2. Size: 2 in (51 mm) wide, 1" (25 mm) deep, as shown in Shop Drawings.

D. Rewind Motor: NFPA 70, 90v DC.

E. Release Mechanism: IAS Accredited Testing Laboratory Labels for UL Standard 864

F. Screen Rewind Switch: Include switch to rewind screen into housing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed.

1. Verify related work performed under other sections is complete and in accordance with Shop Drawings.

2. Verify wall surfaces and elevator door frames are acceptable for installation of smoke containment system components.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

A. Install smoke containment system components in accordance with manufacturer's installation instructions.

3.3 FIELD QUALITY CONTROL

A. Field Test: Follow manufacturer's cycle test procedures.

1. Notify Owner's Representative, local Fire Marshal, alarm sub-contractor and elevator sub-contractor, and elevator service company minimum one week in advance of scheduled testing.
2. Complete maintenance service record.

3.4 DEMONSTRATION

A. Demonstrate required testing and maintenance procedures to Owner's Representative.

B. Maintenance and Testing:

1. Perform minimum semi-annual maintenance and testing on each smoke containment system as required by the manufacturer's warranty, code agency evaluation reports, and as required by local authority having jurisdiction.
2. Retain permanent record of tests.

C. Future Painting: Paint elevator door frame and/or auxiliary rails in accordance with Operation and Maintenance Manual.

D. Qualified Smoke Guard Inspector assesses unit(s) after exposure to a fire event.

END OF SECTION

SECTION 08 4113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior and interior storefront framing.
2. Storefront framing for window walls.
3. Storefront framing for ribbon walls.
4. Storefront framing for punched openings.
5. Exterior and interior manual-swing entrance doors[and door-frame units].

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 08 4126 "All-Glass Entrances and Storefronts" for systems without aluminum support framing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings: For aluminum-framed entrances and storefronts. Include project specific plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

a. Joinery, including concealed welds.

b. Anchorage.

c. Expansion provisions.

d. Glazing.

e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.

2. Anchorage.

3. Expansion provisions.

4. Glazing.

5. Flashing and drainage.

G. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

H. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Mockup Testing Submittals:

1. Testing Program: Developed specifically for Project.

2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.

3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

D. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of storefront systems.

E. Provide the following upon request:

1. Qualification Data: For Installer[and laboratory mockup testing agency][and field testing agency].

2. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

a. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

3. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.

4. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.

5. Source quality-control reports.
6. Field quality-control reports.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration created by wind and thermal and structural movements.
   c. Deterioration of metals[, metal finishes,] and other materials beyond normal weathering.
   d. Water penetration through fixed glazing and framing areas.
   e. Failure of operating components.
2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

2. Failure also includes the following:

a. Thermal stresses transferring to building structure.

b. Glass breakage.

c. Noise or vibration created by wind and thermal and structural movements.

d. Loosening or weakening of fasteners, attachments, and other components.

e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.

2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:
   a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft.300 Pa.
2. Entrance Doors:
   a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
   b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. .

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft. .
   a. Water Penetration: Water leakage to the interior of the building which is not controlled by a weep/drainage system that is integral to the system is a failure. Water observed on interior surfaces of the system or adjacent wall systems is a failure.

H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..
2. Water Penetration: Water leakage to the interior of the building which is not controlled by a weep/drainage system that is integral to the system is a failure. Water observed on interior surfaces of the system or adjacent wall systems is a failure.

I. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

J. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 based on criteria indicated in structural drawings.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.

K. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.38 Btu/sq. ft.x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.23 and 0.27 as determined according to NFRC 200 depending on the glass type. Refer to 088000 for additional information.

L. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 0 deg F.
    c. Interior Ambient-Air Temperature: 75 deg F.

M. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.
2. Designed to produce tensile or shear stress of less than 20 psi.

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Arcadia, Inc.
2. EFCO Corporation.
3. Kawneer North America; an Alcoa company.
4. Oldcastle BuildingEnvelope.
5. United States Aluminum.
6. YKK AP America Inc.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: High-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Thermally Broken Construction:

1. Provide one of the following types of thermal break construction:
   a. Insulbar: A glass-reinforced polyamide 6/6 nylon, with glass fibers oriented in three directions, mechanically crimped into dual dovetail-shaped slots in the aluminum extrusions.
   b. Struct-Link or similar construction as approved: A poured and interrupted debridged polyurethane construction that periodically leaves a measured length of aluminum web to provide structural integrity, with the debridged sections continuously sealed using an elastomeric sealant.
   c. Azon or similar construction as approved: A poured and debridged polyurethane construction with mechanically abraded surfaces that lock in the polyurethane minimizing dry shrinkage and fracturing of the polyurethane.
   d. Pressure Bar: A continuous extruded aluminum member anchored to the window framing system with mechanical fasteners and separated from the framing by an insulating non-metallic spacer.

E. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   a. Sheet and Plate: ASTM B 209.
   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
   d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.

b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.

c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: As indicated.

3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 7100 "Door Hardware."

B. Weather Stripping: Manufacturer's standard replaceable components.

1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

C. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

D. Silencers: BHMA A156.16, Grade 1.

E. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

F. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.6 GLAZING

A. Glazing: Comply with Section 08 8000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

1. Provide gaskets that are compatible with glazing sealants and will provide for silicone adhesion.

C. Glazing Sealants: As recommended by manufacturer.

D. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L.

E. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront system indicated.

1. Color: As selected by Architect from manufacturer's full range of colors.

G. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.

2. Reinforce members as required to receive fastener threads.

3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

E. Shadow Box Construction: For use on the exterior side of the spandrel insulation. 1/8• minimum aluminum plate with concealed stiffeners and attachment clips as required to provide a flat surface free of distortion, buckling, and oil-canning to and meet performance requirements.

1. Color: as indicated on drawings.

F. Spandrel Insulation

1. Basis of Design: Thermafiber FireSpan 90 Curtain Wall Insulation.•

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.10 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.

2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 9200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 08 8000 "Glazing."

F. Install weatherseal sealant according to Section 07 9200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

G. Shadow Box Construction:

1. Install aluminum plate with concealed fasteners.
2. Secure aluminum plate to curtain wall frame and seal fasteners
3. Provide accommodation for curtain movement.
4. Weep and vent shadow box area to the exterior.
5. Tape foil faced insulation to framing in an airtight manner.

H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
   c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.

1. Perform test before installation of interior finishes has begun.
2. Include 12" of adjacent wall construction in the testing area for each test location.
3. Perform testing prior to installation of the following cladding systems, but after cladding attachment systems have been installed.
4. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
   a. Perform a minimum of 250 linear feet (23 m) at transitions to adjacent wall assemblies in.areas as directed by Architect.
   b. Perform tests in each test area as directed by Architect. Perform tests prior to 10, 35, and 70 percent completion.
5. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0/45 L/s per sq. m.) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
   a. Perform a minimum of eight window openings tests in areas as directed by Architect.
   b. Perform tests in each test area as directed by Architect. Perform tests prior to 10, 35, and 70 percent completion.
6. Water Penetration: ASTM E 1105 at a minimum uniform static-air-pressure differential of 8 lbf/sq. ft., and shall not evidence water penetration.
   a. Perform a minimum of eight window openings tests in areas as directed by Architect.
   b. Perform tests in each test area as directed by Architect. Perform tests prior to 10, 35, and 70 percent completion.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 08 4126 - ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior swinging sliding all-glass entrance doors.
2. All-glass sidelights.
3. Interior all-glass storefronts.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for overhead-steel support for all-glass systems.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings: For all-glass entrances and storefronts.

1. Include plans, elevations, and sections.
2. Include details of fittings and glazing, including isometric drawings of patch fittingsand rail fittings.
3. Door hardware locations, mounting heights, and installation requirements.

E. Samples for Verification: For each type of exposed finish indicated, prepared on Samples of size indicated below.

1. Metal Finishes: 6-inch- long sections of patch fittings and rail fittings, accessory fittings, and other items.
2. Glass: 6 inches square, showing exposed-edge finish.
3. Door Hardware: For exposed door hardware of each type, in specified finish, full size.

F. Fabrication Sample: Continuous rail fitting at bottom, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Glazing with butt glazing.

G. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors sidelights, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

H. Delegated-Design Submittal: For all-glass systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

C. Provide the following upon request:

1. Qualification Data: For Installer.
2. Product Test Reports: For all-glass systems, for tests performed by manufacturer and witnessed by a qualified testing agency.
3. Field quality-control reports.

1.7 WARRANTY

A. Special Warranty: Manufacturer Installer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including excessive deflection.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   c. Failure of operating components.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design all-glass entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

C. Structural Loads:

1. Deflection Limits: Deflection normal to glazing plane is limited to 1/175 of clear span or 3/4 inch, whichever is smaller.

D. Seismic Performance: All-glass entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" California Building Code Chapter 11B "Accessibility to Public Buildings, Public Accomodations, Commercial Buildings and Publically Funded Housing".

2.2 METAL COMPONENTS

A. Fitting Configuration:

1. Manual-Swinging, All-Glass Entrance Doors Sidelights: Patch fitting at top and continuous rail fitting at bottom.
2. Manual-Sliding, All-Glass Entrance Doors Sidelights: Continuous rail fitting at top and bottom.
3. All-Glass Storefronts: Recessed glazing channel at top and continuous rail fitting at bottom.

B. Patch Fittings: Stainless-steel-clad aluminum.

C. Rail Fittings:

1. Material: Stainless-steel-clad aluminum.
2. Height:
   a. Bottom Rail: 3-1/2 inches.
3. Profile: Tapered .
4. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.

D. Accessory Fittings: Match patch- and rail-fitting metal and finish for the following:

1. Overhead doorstop.
2. Center-housing lock.

E. Anchors and Fastenings: Concealed.

F. Materials:

1. Aluminum: ASTM B 221, with strength and durability characteristics of not less than Alloy 6063-T5.
2. Stainless-Steel Cladding: ASTM A 666, Type 304.
   a. Finish: No. 4 directional satin finish.

2.3 GLASS

A. Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.
   a. Thickness: 1/2 inch.
   b. Locations: As indicated.
2. Exposed Edges: Machine ground and flat polished.
3. Butt Edges: Flat ground.

4. Corner Edges: Lap-joint corners with exposed edges polished.

2.4 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of patch fittings and rail fittings.

B. Concealed Floor Closers and Top Pivots: Center hung; BHMA A156.4, Grade 1; including cases, bottom arms, top walking beam pivots, plates, and accessories required for complete installation.

1. Swing: Single acting.
   a. Positive Dead Stop: Coordinated with hold-open angle if any, or at angle selected.
2. Opening-Force Requirements:
   a. Egress Doors: Not more than 5 lbf to release the latch and not more than 30 lbfto set the door in motion and not more than 5 lbf to open the door to its minimum required width.
   b. Accessible Interior Swinging Sliding Doors: Not more than 5 lbf to fully open door.

C. Concealed Overhead Holder: BHMA A156.8, Grade 1, with dead-stop setting coordinated with concealed floor closer.

D. Push-Pull Set: As selected from manufacturer's full range.

E. Single-Door and Active-Leaf Locksets: Center-housing combination deadbolt and latchbolt with lever handles.

1. Deadbolt operated by key outside and thumb turn inside.

F. Inactive-Leaf Locksets: Bottom-fitting or bottom-rail deadbolt.

G. Cylinders: As specified in Section 08 7100 "Door Hardware."

H. Exit Devices: UL 305.

1. Function: Operation by push-pull when inside operator is locked down (dogged).
2. Latching: At door head.
3. Style: Exposed vertical rod.
4. Provide exit devices on both leaves of pairs of doors.

I. Manual-Sliding Entrance Door Hardware: Manufacturer's standard for sliding action indicated and with twin rollers.

1. Type: Top-hung, stacking partition.

2.5 BUTT-GLAZING SEALANTS

A. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Uses NT, G, and A.

B. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.6 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts according to manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install butt-joint sealants according to manufacturer's instructions and as specified in Section 07 9200 "Joint Sealants" to produce weathertight installation.

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

1. For all-glass entrance doors accessible to people with disabilities, adjust closers to provide a three-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION

SECTION 08 4229.33 - SWINGING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior, swinging, power-operated automatic entrances.

B. Related Requirements:

1. Section 08 7113 "Automatic Door Operators" for automatic door operators furnished separately from doors and frames.

1.3 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. Double-Egress Doors: A pair of doors that simultaneously swing with the two doors moving in opposite directions with no mullion between them.

D. Double-Swing Doors: A pair of doors that swing with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.

~~E. IBC: International Building Code.~~

F. CBC: California Building Code.

G. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

H. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

1.4 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified elsewhere.

B. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.

C. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.

D. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic entrances.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.

2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

4. Indicate locations of activation and safety devices.

5. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a Certified Inspector.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

C. Certified Inspector Qualifications: Certified by AAADM.

D. Accessibility: Comply with requirements of the 2010 ADA Standards and 2013 CBC 11B.

E. Provide the following upon request:

1. Qualification Data: For Certified Inspector.

2. Product Certificates: For each type of automatic entrance. Include emergency-exit features of automatic entrances serving as a required means of egress.

3. Product Test Reports: For each type of automatic entrance, for tests performed by a qualified testing agency.

4. Field quality-control reports.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

b. Faulty operation of operators, controls, and hardware.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

A. Source Limitations: Obtain swinging automatic entrances from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Power-Operated Door Standard: BHMA A156.10.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Operating Temperature Range: Automatic entrances shall operate within minus 20 to plus 122 deg F.

D. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance-system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..

E. Opening Force:

1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 5 lbf required to open door to minimum required width.
2. Power-Operated Swinging Doors: Not more than 30 lbf required to manually open door if power fails.
3. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.
4. Comply with 2013 CBC 11B.309.4.

F. Entrapment-Prevention Force:

1. Power-Operated Swinging Doors: Not more than 40 lbf required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than 30 lbf required to prevent stopped door from moving in direction of closing.

2.3 SWINGING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances including doors, framing, headers, door operators, controls, and accessories required for a complete installation.

B. Swinging, Power-Operated Automatic Entrance :

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Arcadia, Basis of Design
   b. Besam Entrance Solutions; Subsidiary of ASSA ABLOY Entrance Systems.
   c. Horton Automatics; a division of Overhead Door Corporation.
   d. Stanley Access Technologies, LLC; Division of Stanley Security Solutions.

2. Configuration: Single-swinging door.
   a. Traffic Pattern: Two way.
   b. Mounting: Between jambs.
3. Configuration: Pair of swinging doors.
   a. Traffic Pattern: Two way.
   b. Mounting: Between jambs.
4. Operator Features:
   a. Power opening and power-assist spring closing.
   b. Adjustable opening and closing speeds.
   c. Adjustable hold-open time between zero and 30 seconds.
   d. Adjustable backcheck and latching.
   e. Obstruction recycle.
   f. Automatic door re-open if stopped while closing.
   g. On-off/hold-open switch to control electric power to operator, key operated.
5. Controls: Activation and safety devices as indicated on Drawings and according to BHMA standards.
   a. Activation Device: Motion sensor mounted on ingress side of door header to detect pedestrians in activating zone and to open door.
   b. Safety Device: Presence sensor mounted on door header to detect pedestrians in presence zone and to prevent door from closing.
6. Finish: Finish framing, door(s), and header with finish matching adjacent curtain wall.

2.4 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
   1. Nominal Size: As indicated on Drawings .

B. Stile and Rail Doors: 1-3/4-inch- thick, glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.

C. Sidelite(s): 1-3/4-inch- deep sidelite(s) with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members matching door design.
   1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.

D. Headers: Fabricated from minimum 0.125-inch- thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
   1. Mounting: Concealed, with one side of header flush with framing.

E. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.

F. Signage: As required by cited BHMA standard.

1. Provide sign materials with instructions for field application after glazing is installed.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.

2. Sheet: ASTM B 209.

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Glazing: As specified in Section 08 8000 "Glazing."

D. Sealants and Joint Fillers: As specified in Section 07 9200 "Joint Sealants."

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by its plastic housing; adjustable to provide detection-field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bidirectional and unidirectional detection.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Key Switch: Recess-mounted, door-control switch with key-controlled actuator; enclosed in 2-by-4-inch junction box. Provide faceplate engraved with letters indicating switch functions.

1. Face-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.

2. Functions: Two-way automatic, hold open, one-way exit, off, full open, and partial open.

F. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Manual Opening for Power-Operated Swinging Doors: Provide hardware that, in a power failure, allows door to open with a manual force stipulated in "Performance Requirements" Article.

C. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch- long throw bolt; BHMA A156.5, Grade 1.

1. Two-Point Locking for Swinging Doors: Mechanism in stile of active door leaf that automatically extends second lockbolt into threshold

D. Push Bars: Manufacturer's standard surface-mounted, aluminum push bars.

E. Pull Handles: Manufacturer's standard aluminum pull handles.

F. Thresholds: BHMA A156.21, extruded-aluminum raised thresholds; with beveled edges with a slope of not more than 1:2 and a maximum height of 1/2 inch. Provide cutouts as required for door operating hardware.

G. Weather Stripping: Replaceable components.

1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

3. Weather Sweeps: Nylon brush sweep mounted to underside of door bottom.

H. Finger Guards: Collapsible neoprene or PVC gasket.

2.8 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

1. Form aluminum shapes before finishing.
2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, fabricated from stainless steel.
    a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
    b. Reinforce members as required to receive fastener threads.
4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
3. Form profiles that are sharp, straight, and free of defects or deformations.
4. Provide components with concealed fasteners and anchor and connection devices.
5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
6. Fabricate exterior components to drain condensation and water passing joints within system to the exterior.
7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
8. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

E. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

F. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.

2.9 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Provide thresholds at exterior doors.

C. Door Operators: Connect door operators to electrical power distribution system.

D. Access-Control Devices: Connect access-control devices to access-control system as specified in Section 28 1300 "Access Control."

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

F. Glazing: Install glazing as specified in Section 08 8000 "Glazing."

G. Sealants: Comply with requirements specified in Section 07 9200 "Joint Sealants" to provide weathertight installation.

1. Set thresholds, framing members, and flashings in full sealant bed.
2. Seal perimeter of framing members with sealant.

H. Signage: Apply signage on both sides of each door and breakaway sidelite as required by cited BHMA standard for direction of pedestrian travel.

I. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust exterior doors for weathertight closure.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 CLEANING

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

1. Comply with requirements in Section 08 8000 "Glazing" for cleaning and maintaining glass.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic entrance Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.

2. Perform maintenance, including emergency callback service, during normal working hours.

3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION

SECTION 08 4413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes conventionally glazed aluminum curtain walls installed as assemblies.

B. Related Sections:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 07 9200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls[and for sealants to the extent not specified in this Section].

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Periodic Maintenance-Equipment Loads: Minimum 250 pounds point load any place on mullions.
3. Structural-Test Performance: Test according to ASTM E 330 as follows:

a. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.

b. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.

c. Test Durations: As required by design wind velocity, but not less than 10 seconds.

4. Deflection of Framing Members: At design wind pressure, as follows:

a. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

b. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

c. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.

5. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 based on criteria indicated in structural drawings.

6. Story Drift: Accommodate design displacement of adjacent stories indicated.

a. Design Displacement: As indicated on Drawings.

b. Test Performance: Meeting criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

D. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft..

1. Water Penetration: Water leakage to the interior of the building which is not controlled by a weep/drainage system that is integral to the system is a failure. Water observed on interior surfaces of the system or adjacent wall systems is a failure.

E. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft. .

1. Water Penetration: Water leakage to the interior of the building which is not controlled by a weep/drainage system that is integral to the system is a failure. Water observed on interior surfaces of the system or adjacent wall systems is a failure.

F. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Test Interior Ambient-Air Temperature: 72 deg F.
3. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

G. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.38 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.23 and 0.27 as determined according to NFRC 200 depending on the glass type. Refer to 088000 for additional information.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For glazing sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings: For glazed aluminum curtain walls. Include project specific plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.

e. Flashing and drainage.

3. Include laboratory mockup Shop Drawings, prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.
   a. Submit mockup system Shop Drawings only after approval of wall system Shop Drawings.
   b. Resubmit Shop Drawings with changes made to glazed aluminum curtain walls to successfully complete preconstruction testing.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes. Include 2 or more samples in each set, indicating limits of variation.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   3. Expansion provisions.
   4. Glazing.
   5. Flashing and drainage.
   6. Cross-sectional sample of curtain wall showing thermal break construction.

G. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Mockup Submittals:
   1. Preconstruction Testing Program: Developed specifically for Project.
   2. Preconstruction Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
   3. Photographs:
      a. Take and submit photographs at locations and intervals as required to accurately document mockup construction and testing.
      b. Submit digital color images on CD-R of mockup before, during, and after preconstruction testing.
   4. Record Drawings: Submit record drawings of preconstruction mockups prepared by preconstruction testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

F. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.

G. Provide the following upon request:

1. Qualification Data: For qualified Installer and testing agency.
2. Seismic Qualification Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
    a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
3. Welding certificates.
4. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
    a. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
5. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum curtain walls, indicating compliance with performance requirements.
6. Field quality-control reports.

H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Furnish all labor and materials to completely erect mockup unit of sufficient size and configuration to demonstrate the performance capabilities of the vertical wall system. Schedule mockup erection and testing sufficiently in advance of wall system fabrication to cause no delay. Do not install mockup materials as part of the wall system.

2. After completion of mockup construction and prior to start of testing sequence two vision glass lites and two spandrel panels are to be removed and replaced to successfully demonstrate project reglazing procedures.

3. Build mockup of typical wall area as shown on Drawings.

4. Mockup shall have all details complete and identical to those approved on the wall system shop drawings. Mockup shall demonstrate quality of materials, finish, and workmanship, as well as compliance with performance requirements.

5. Provide schedule for mockup fabrication, erection, glazing, sealing and testing a minimum of 30 days in advance of fabrication to permit owner and Architect to coordinate monitoring and observation.

6. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.

7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

9. Comply with Section 01 4339 "Exterior Walls Mockups".

I. Preinstallation Conference: Conduct conference at Project site.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Assembly Warranty: Standard form in which manufacturer Installer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration created by wind and thermal and structural movements.
   c. Deterioration of metals[, metal finishes,] and other materials beyond normal weathering.

d. Water penetration through fixed glazing and framing areas.

e. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Arcadia, Inc.

2. EFCO Corporation.

3. Kawneer North America; an Alcoa company.

4. United States Aluminum; C. R. Laurence Co., Inc.

5. Vistawall Architectural Products; Oldcastle Building Envelope.

6. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

3. Extruded Structural Pipe and Tubes: ASTM B 429.

4. Structural Profiles: ASTM B 308/B 308M.

5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.

B. Thermally Broken Construction:

1. Provide one of the following types of thermal break construction:
   a. Insulbar: A glass-reinforced polyamide 6/6 nylon, with glass fibers oriented in three directions, mechanically crimped into dual dovetail-shaped slots in the aluminum extrusions.
   b. Struct-Link or similar construction as approved: A poured and interrupted debridged polyurethane construction that periodically leaves a measured length of aluminum web to provide structural integrity, with the debridged sections continuously sealed using an elastomeric sealant.
   c. Azon or similar construction as approved: A poured and debridged polyurethane construction with mechanically abraded surfaces that lock in the polyurethane minimizing dry shrinkage and fracturing of the polyurethane.
   d. Pressure Bar: A continuous extruded aluminum member anchored to the window framing system with mechanical fasteners and separated from the framing by an insulating non-metallic spacer.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.

E. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. Framing Sealants: Manufacturer's standard sealants with VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA method 24).

2.4 GLAZING

A. Glazing: Comply with Section 08 8000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

1. Provide gaskets that are compatible with glazing sealants and will provide for silicone adhesion.

C. Glazing Sealants: As recommended by manufacturer.

1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 ACCESSORY MATERIALS

A. Shadow Box Construction: For use on the exterior side of the spandrel insulation. 1/8• minimum aluminum plate with concealed stiffeners and attachment clips as required to provide a flat surface free of distortion, buckling, and oil-canning to and meet performance requirements.

1. Color: as indicated on drawings.

B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

C. Spandrel Insulation

1. Basis of Design: Thermafiber FireSpan 90 Curtain Wall Insulation• .

2.6 FABRICATION

A. Form aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Touch-up all aluminum cut edges that will be exposed to view with color similar to curtain wall finish.
8. Provide framing members that have adequate surface to accommodate two lines of air and water sealant joints between curtain walls and adjacent construction.
9. Provide watertight caps at perimeter framing members to accommodate sealant joints between curtain walls and adjacent construction.

D. Fabricate components that, when assembled, have the following characteristics:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Seal joints watertight unless otherwise indicated.
3. Install glazing to comply with requirements in Section 08 8000 "Glazing."

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 MOCKUP APPROVAL

A. Do not proceed with erection of curtain wall work before completion and approval of mockups.

3.2 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Approved mockups establish acceptable workmanship and quality standards of the Project.

C. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Install components plumb and true in alignment with established lines and grades.

F. Shadow Box Construction:

1. Install aluminum plate with concealed fasteners.
2. Secure aluminum plate to curtain wall frame and seal fasteners

3. Provide accommodation for curtain movement.
4. Weep and vent shadow box area to the exterior.
5. Tape foil faced insulation to curtain wall frame in an airtight manner.

G. Install glazing as specified in Section 08 8000 "Glazing."

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
   c. Where surfaces are separated by reveal or protruding element of 1 inchwide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.

1. Perform test before installation of interior finishes has begun.
2. Include 12" of adjacent wall construction in the testing area for each test location.
3. Perform testing prior to installation of the following cladding systems, but after cladding attachment systems have been installed.
4. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..
   a. Test Area: One bay wide, but not less than 30 feet, by one story of glazed aluminum curtain wall.
   b. Perform a minimum of three tests in areas as directed by Architect.
   c. Perform tests in each test area as directed by Architect. Perform tests prior to 10, 35, and 70 percent completion.

5. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.
    a. Test Area: One bay wide, but not less than 30 feet, by one story of glazed aluminum curtain wall.
    b. Perform a minimum of three tests in areas as directed by Architect.
    c. Perform tests in each test area as directed by Architect. Perform tests prior to 10, 35, and 70 percent completion.
6. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    a. Test Area: A minimum of 200 linear feet of the inside and outside corners of the glazed aluminum curtain wall and at transitions to adjacent wall assemblies..
    b. Perform tests in each test area as directed by Architect. Perform tests prior to 10, 35, and 70 percent completion.

C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.

1. Door hardware for metal doors & frames
2. Door hardware for wood doors
3. Door hardware for other doors indicated
4. Keyed cylinders specified in other Sections

B. Related Sections:

1. Division 6: Rough Carpentry.
2. Division 8: Aluminum Doors and Frames
3. Division 8: Hollow Metal Doors and Frames
4. Division 8: Wood Doors
5. Division 8: FRP Doors and Frames
6. Division 26: Electrical
7. Division 28: Electronic Security

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. Builders Hardware Manufacturing Association (BHMA)
2. NFPA 101 Life Safety Code
3. NFPA 80 -Fire Doors and Windows
4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
5. UL10C – Positive Pressure Fire Test of Door Assemblies
6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
8. CBC California Building Code

D. Intent of Hardware Groups

1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

1.2 SUBSTITUTIONS:

A. Comply with Division 1.

1.3 SUBMITTALS:

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with related Sections to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 5 copies of catalog cuts with hardware schedule.

D. Shop Drawings - Hardware Schedule: Submit 5 complete reproducible copy of detailed hardware schedule. Organize vertically formatted schedule into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Door and frame sizes and materials.
4. Degree of opening
5. Manufacturer, product name, and catalog number.
6. Function, type, and style.
7. Size and finish of each item.
8. Fastenings and other pertinent information
9. Mounting heights.
10. Explanation of abbreviations and symbols used within schedule.
11. Description of operation for each electro-mechanical hardware application.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

1. Templates, point to point wiring diagrams and "reviewed Hardware Schedule" including electrical terms to electrical and security contactor for coordination and verification of voltages and locations where electro-mechanical hardware is included.

F. Samples: (If requested by the Architect)

1. 1 sample of Lever and Rose/Escutcheon design, (pair).
2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.

   a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Name, address, and phone number of local representative for each manufacturer.
   d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. As installed point to point “Wiring Diagrams” for each piece of hardware connected to power, both low voltage and 110 volts.

One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.

    a. Distributor to employ full time Architectural Hardware Consultants (AHC) or similar with 3 years experience for the purpose of scheduling and coordinating hardware and establishing keying schedule.
    b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.

    a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
    b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.

6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Fire Rated Openings:

1. NFPA 80 compliant and as required by local governing agencies.
2. Electric latch retraction: Provide power supplies with fire alarm relay.
3. Hardware: UL10C/ UBC Standard 7-2 (positive pressure) compliant.
4. Provide proper latching hardware, self closing, approved bearing hinges, and seals.
5. Coordinate with wood door section on intumescent seals.
6. Provide approved gasketing at storage rooms over 100 sqft.

C. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

D. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

E. **Pre-Installation Meetings**: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Convene at least one week prior to commencement of related work.

1.5 REGULATORY REQUIREMENTS

A. Fire-Rated Openings: Comply with CBC Section 716 and NFPA Standard No. 80. Provide only hardware tested and listed by UL for the type and size of each door required, which complies with the requirements of the door and frame labels.

1. Where exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating "Fire Door to be Equipped with Fire Exit Hardware", and provide UL Label on exit device indicating "Fire Exit Hardware".

B. Conform to applicable requirements of the Americans with Disabilities Act Standards for Accessible Design regarding accessibility requirements for door and entrance hardware.

C. Doors and doorways that are part of an accessible route shall comply with CBC Sections 11B-404.

D. The clear opening width for a door shall be 32 inches minimum. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into the opening below 34 inches and 4 inches maximum projections into the opening between 34 inches and 80 inches above the finish floor or ground. Door closers and stops shall be permitted to be 78 inches minimum above the finish floor or ground. CBC Section 11B-404.2.3.

E. Handles, pulls, latches, locks, and other operable parts on accessible doors shall comply with CBC Section 11B-309.4 and shall be operable with one hand and not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34 inches minimum and 44 inches maximum above the finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides. CBC Section 11B-404.2.7.

1. Non-fixed portions of locks and other operable parts, such as keys and access cards, are not required to comply.

F. The force for pushing or pulling open a door shall be as follows: CBC Section 11B-404.2.9.

1. Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 lbs. (22.2N) maximum.

2. Required fire doors: the minimum opening force allowable by the AHJ, not to exceed 15 lbs. (67N) maximum.

3. The force required to activate any operable parts, such as retracting latch bolts or disengaging other devices shall be 5 lbs. (22.2N) maximum to comply with CBC Section 11B-309.4 unless operators or electrical means to retract these latches is provided.

G. Door closing speeds shall be as follows: CBC Section 11B-404.2.8.

1. Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum.

2. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.

H. Thresholds shall comply with CBC Section 11B-404.2.5.

I. Floor stops shall not be located in the path of travel and 4 inches maximum from wall, per DSA Policy 99-08.

J. Hardware (including exit devices) shall not be provided with Night Latch (NL) function for any accessible doors or gates unless the following conditions are met per DSA Interpretation 10-08 DSA / AC (External), revised 4/28/09. Such conditions must be clearly demonstrated and indicated in the specifications:

1. Such hardware has a dogging feature.

2. It is dogged during the time the facility is open.

3. Such dogging operation is performed only by employees as their job function (non-public use).

K. Pair of doors: Limit swing of one leaf to 90 degrees so that a clear floor space is provided beyond the arc of the swing for the wall-mounted tactile sign. CBC Section 11B-703.4.2.1.

L. Exit device touchpad shall be compliant with State Fire Marshall Standard 12-10-3, Section 12-10-302.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.7 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

C. Coordinate conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.

1.8 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer’s Warranty:

1. Closers: Ten years
2. Exit Devices: Three Years
3. Locksets & Cylinders: Three years

4. All other Hardware: One years.

1.9 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.10 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

Item:	**Manufacturer:**	**Approved:**
Hinges	**Stanley**	**McKinney**
Continuous Hinges	**Stanley**	**Pemko**
Locksets	**Schlage**	**None**
Exit Devices	**Von Duprin**	**None**
Closers	**LCN**	**None**
Door Stops	**Trimco**	**Don Jo, Rockwood**
Flush Bolts	**Trimco**	**Don Jo, Rockwood**
Coordinator & Brackets	**Trimco**	**Don Jo, Rockwood**
Threshold & Gasketing	**NGP**	**Reese, Zero, Pemko**

2.2 MATERIALS:

A. Fasteners:

1. Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

a. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use

through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

b. Fire-Rated Applications:
   1) Wood or Machine Screws: For the following:
      a) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      b) Strike plates to frames.
      c) Closers to doors and frames.

   2) Steel Through Bolts: For the following unless door blocking is provided:
      a) Surface hinges to doors.
      b) Closers to doors and frames.
      c) Surface-mounted exit devices.

2. Fasteners exposed to the weather or corrosive environments in the finished work shall be completely non-ferrous.

3. Dissimilar Metals: Provide fasteners and base materials that prevent extreme galvanic corrosion based on their environment. Rain, dew, snow, high humidity, and ocean salt spray must all be taken into account of their reactivity of the metals being joined.

B. Hinges:

1. Template screw hole locations
2. Minimum of 2 permanently lubricated non-detachable bearings
3. Equip with easily seated, non-rising pins
4. Sufficient size to allow 180-degree swing of door
5. Furnish hinges with three knuckles and flush concealed bearings
6. Provide hinge type as listed in schedule.
7. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
9. UL10C listed for Fire
10. Provide electric hinge wires with junction box (JB-2R series) to protect wires from mortar filled frames as required.
11. Security studs at exterior doors.
12. NRP at out-swinging doors
13. Anchor hinges at classrooms and doors with panic hardware
14. Two extra wires for electric hinges
15. Provide heavy weight hinges for door 42” in width and higher.

C. Geared Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3 hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings
7. Sufficient size to permit door to swing 180 degrees

D. Pin and Barrel Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Fabricated from 14 gauge material
3. UL and ULC listed
4. Slim barrel design
5. Twin nylon self-lubricating bearings located between all knuckles except top and bottom.
6. Two stainless steel bearings top and bottom, to prevent sagging if nylon bearings degrade during a fire.
7. Limited Lifetime warranty
8. Provide type as specified

E. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C
2. Fit ANSI A115.1 door preparation
3. Functions and design as indicated in the hardware groups
4. Solid, one-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel
5. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel
6. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
7. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated
8. Provide curved-lip strike with dust box for each latch or lock bolt, with lip extended to protect frame, finished to match door hardware set, unless otherwise indicated.
9. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
10. Lock shall have self-aligning, thru-bolted trim
11. Levers to operate a roller bearing spindle hub mechanism
12. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
13. Spindle to be designed to prevent forced entry from attacking of lever
14. Provide locksets with removable and interchangeable core cylinders
15. Each lever to have independent spring mechanism controlling it
16. Core face must be the same finish as the lockset

F. Exit Devices shall:

1. Tested and approved by BHMA for ANSI 156.3, Grade 1
2. Provide 9001-Quality Management and 14001-Environmental Management.
3. Furnish UL or recognized independent laboratory certified mechanical operational testing to 9 million cycles minimum.
4. Provide a deadlocking latchbolt
5. Touchpad shall be “T” style with beveled end caps - no overhang to catch clothing
6. Exposed components shall be of true architectural metals and finishes.
7. Lever design shall match lockset lever design
8. Provide strikes as required by application.
9. Fire exit devices to be listed for UL10C
10. UL listed for Accident Hazard
11. Shall consist of a cross bar or push pad, the actuating portion of which extends across, shall not be less than one half the width of the door leaf.
12. Provide vandal resistant or breakaway trim
13. Sex bolts only at fire doors unless specified for non-rated doors.
14. Full cover end caps with robust end cap mounting bracket

G. Cylinders:

1. Provide cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Provide cylinder guards for all exposed cylinders at exterior perimeter doors.
4. Coordinate and provide as required for related sections.

H. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Closer shall have extra-duty arms and knuckles where required
4. Conform to ANSI 117.1
5. Maximum 2 7/16 inch case projection with non-ferrous cover
6. Separate adjusting valves for closing and latching speed, and backcheck
7. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
8. Full rack and pinion type closer with 1½“ minimum bore
9. Mount closers on non-public side of door, unless otherwise noted in specification
10. Closers shall be non-handed, non-sized and multi-sized 1 through 6
11. Provide BF or barrier free at non rated doors as required per code

I. Door Stops:

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

J. Flush Bolts:

1. Automatic flush bolts shall meet ANSI/BHMA A156.3
2. Manual flush bolts shall meet BHMA A156.16 requirements.
3. Bottom bolt shall have 12 inch (305 mm) long operating rod. Top bolt operating rod shall be determined by door height, assuring the operator is located less than 72 inches (183 cm) above the floor.
4. Manual Flush Bolts are not to be utilized except where a pair of non-rated doors serving a room not normally occupied is needed for the movement of equipment.
5. Provide dust proof strikes for bottom bolts. Dust proof strikes shall meet BHMA A156.16.

K. Coordinator and Brackets:

1. Coordinator shall comply with ANSI/BHMA A1156.3 Type 21A full width of the opening.
2. Provide mounting brackets for soffit applied hardware.
3. Provide hardware preparation (cutouts) for latches as necessary.

L. Push Plates: Provide with four beveled edges ANSI J301, .050 thickness, size as indicated in hardware set. Furnish oval-head countersunk screws to match finish.

M. Pulls with plates: Provide with four beveled edges ANSI J301, .050 thickness Plate s with ANSI J401 Pull as listed in hardware set. Provide proper fasteners for door construction.

N. Kick Plates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2.5 inches on single doors and on pairs of doors. Furnish oval-head countersunk screws to match finish. Provide 16 gauge, stainless steel, beveled 3 edges.

O. Mop Plates: Provide with four beveled edges ANSI J103, 6 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish. Provide 16 gauge, stainless steel, beveled 3 edges.

P. Armor Plates: Provide ANSI J101 with three beveled edges, required inches high by width less 2.5 inch on single or pairs of doors. Furnish oval-head countersunk screws to match finish.

1. Provide cutouts for hardware as listed in the hardware sets.
2. Provide Warnock Hersey labeled plates for 3 hour metal fire doors where allowed by local authority.
3. Provide 16 gauge, stainless steel, beveled 3 edges.

Q. Edge Guards: Provide full height type as specified.

R. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

S. Door Bottoms: Surface mounted or concealed door bottom where listed in the hardware sets.

1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.
3. Coordinate door bottom with threshold height and door undercut such that door bottom provides accurate seal with threshold without binding door or preventing positive latching.
4. Notch as required for adjacent hardware.

T. Thresholds: Thresholds shall be aluminum and/or stainless steel type as specified for conformance with ADA requirements. Furnish as specified and/or per details. Provide fasteners and screws suitable for floor conditions.

1. Thresholds shall be prepared to accommodate floor closers, pivots, and projecting bolts of latching hardware.
2. Thresholds at exterior shall be “stainless steel”
3. Refer to Door Schedule and Drawing details for type and configuration required. Additionally, where combustible flooring passes under doors, provide fire door thresholds in accordance with applicable regulatory requirements.
4. Saddle, offset, and bumper seal type thresholds as required for applications.
5. Cut and notch exterior thresholds for frame stop/soffit/rabbets.
6. Miter and wrap exterior thresholds to frame
7. Provide non-slip surface at exterior thresholds
8. Provide aluminum thresholds for interior openings.

U. Key Control: Provide one wall mounted Telkee type RWC-S series key cabinet complete with hooks, index and tags to accommodate 25% expansion. Coordinate location with Architect. Provide submittal for review before fabrication or ordering.

V. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

W. Knox Co, 3200 Series: Subject to compliance with requirements provide as required.

1. Recessed mount, UL-listed, heavy-duty unit; fabricate from 1/4-inch-thick steel plate.

2. Provide with restricted keying as required by Local Fire Department.
3. Provide one box at each main entry from each parking area designated with a fire emergency lane, or as required by Campus Fire Marshal.
4. Provide tamper alarm switch with each box.
5. Provide outlet boxes, conduit, wiring, and connections as specified in appropriate Division 25-28 Sections.
6. Coordinate finish as required with Architect

X. Power Transfer: Power transfer device shall be a stainless steel housing and concealing tube. Secure and inconspicuous channel is to bring power from the frame to the door.

1. Tube shall accept up to 5/16” wire bundle and accommodate a door swing of 120 or 180 Degrees based on door and frame conditions. “UL Listed” as Miscellaneous Fire Door Accessory. Coordinate position in door and frame with other hardware applications.
2. Wires as required by others

Y. Door Position Switch: Provide door position switch for door status monitoring as indicated in hardware sets.

1. At all fired rated door and frames the [concealed] position switch preparation will be provided by the door and frame manufacturer or by an authorized label service agent.

Z. Magnetic Door Holders: Provide magnetic door holders with Tri-Voltage that can be wired 12VDC, 24V AC/DC or 120V AC

1. Wall magnetic door holders type as specified
2. Armature shall be thru-bolted and can be provided with any projection required.
3. 630 finish
4 Integrate with UL listed fire/life safety alarm systems
5. Provide armature extensions as required for clearance of projecting hardware
6. Tri-voltage
7. No plastic parts

AA. Electric Door Strike: Certified by ANSI/BHMA 156.31, Grade 1. and listed for Burglary Protection ANSI/ UL1034 Grade 1.

1. For General use provide fail-secure electric strike and with fire-rated device.
2. Listed UL10C for Fire Door assemblies
3. Latchbolt monitor switch option when specified in hardware sets.
4. Provide the electric strike in the appropriate model that will accept a 5/8” or 3/4" latchbolt.

2.3 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.5, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys will be furnished to the Owner for final keying.

B. Cylinders, removable and interchangeable core system: 20-740 Primus Core

1. Provide uncut keys for final keying by Owner/Campus Locksmith. For estimate furnish uncut keys as indicated below.

C. Permanent keys and cores: Provide 0 bitted cores to the Campus Locksmith for final keying. Permanent keys will be stamped "Do Not Duplicate."

D. Transmit uncut keys as directed by the Owner or campus locksmith.

E. For Estimate furnish keys in the following quantities:
1. 3 each Change keys each keyed core
2. 15 each Construction masterkeys
3. 10 each Control keys

F. Bitting List: Will be generated by Owner/Campus locksmith no transmission will be made to construction team.

G. The Owner, or the Campus locksmith, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

H. Keying Schedule: Will be generated by the Campus Locksmith. No transmission will be made to the construction team.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations or facility standards.

1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
2. NWWDA Industry Standard I.S.1.7, Hardware Locations for Wood Flush Doors.

3.3 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level,

plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. ADA Standard: Conform to ANSI A117.1 for positioning requirements for disabled.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

E. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.

1. Adjust door closer sweep period so that from an open position of 90 degrees, the time required to move the door from to a position of 12 degrees from the latch is 5 seconds minimum.

F. Closers: Coordinate installation of closer for maximum degree of hold open or opening. Hold open arms to stop door from hitting wall. Closers typically mount on interior side of room.

G. Locksets: Provide appropriate backset to center lockset on stile and rail type doors.

H. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

I. Thresholds: Set thresholds for exterior doors in full bed of sealant complying with requirements specified in Division 7 Section “Joint Sealants.” Securely and permanently anchor exterior thresholds using countersunk non-ferrous screws to match color of threshold. Stainless steel screws at aluminum thresholds. Set thresholds at interior acoustical rated openings with acoustical sealant.

J. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, verify location with Architect.

K. Mount cylinder keyways in proper position as recommended by manufacturers

L. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals where possible. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.

M. Replace fasteners damaged by power-driven tools.

N. Silencers: Set in place before adjusting strikes.

O. Raindrips: Set in waterproof sealant and fasten as recommended by manufacturer.

P. Floor Stops: Floor stops shall be installed a maximum of 4 inches from adjacent walls.

Q. Auto Door Bottom shall not be adjusted until substantial completion. Door bottoms are to be raised to highest position while construction occurs (so to not have rubber seal torn or damaged by debris under the door). At substantial completion, adjust door bottom to fully engage and touch the floor for proper sound dampening.

R. Hardware Installer shall coordinate with Security contractor to route cable to connect electrified locks, panic hardware, and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.

S. Hardware Installer shall also be present with the security contactor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closer to insure proper and secure operation

T. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for the Electrical Section.

U. Conductors shall be minimum 18 gage stranded multicolored unless specified otherwise. A minimum 12 inch loop for conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.

V. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacture's technical documentation.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.

    a. Adjust "Backcheck" according to manufacturer's instructions.
    b. Set exterior doors closers to have 5 lbs maximum pressure to open, interior non-rated at 5 lbs, rated openings comply with local code.

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

    a. Verify levers are free from binding.
    b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect and hardware supplier outlining corrective actions and recommendations.

3.5 HARDWARE SETS:

A. See door schedule in drawings for hardware set assignments.

B. The hardware sets represent the product design intent and direction of the owner and architect. They should not be considered a detailed hardware schedule. Detailed or omitted items not included in the following hardware set(s) should be scheduled and submitted with the appropriate additional hardware required for proper application and functionality.

C. Manufacturer's Abbreviations:

1. SC Schlage
2. PE Pemko
3. VD Von Duprin
4. RO Rockwood
5. TR Trimco
6. ST Stanley
7. LC LCN

8. AB ABH Manufacturing
9. DJ Don Jo
10. AD Adams Rite
11. WK Wikk Industries

Hardware Sets

SET #001

Doors: OST 01B

1	Continuous Hinge	661HD x Sch Option	AL	ST
1	Exit Device	LD 98L-NL SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Base Stop	1475	626	DJ
1	Perimeter Seal	2891AS @ Head		PE
1	Perimeter Seal	290AS @ Jambs		PE
1	Door Sweep	345CNB		PE
1	Stainless Steel Threshold	Per Detail x SS	US32D	PE

SET #002

Doors: 0304C3

1	Continuous Hinge	661HD EPT x Sch Option	AL	ST
1	Exit Device	AX RX LD EL 98L-NL SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Latch Protector	NLP-110	630	DJ
1	Door Closer	4111EDA	689	LC
1	Base Stop	1475	626	DJ
1	Perimeter Seal	2891AS @ Head		PE
2	Perimeter Seal	290AS @ Jambs		PE
1	Door Sweep	345CNB		PE
1	Threshold	Per Detail	AL	PE
1	Drip Cap	346C 4” ODW		PE
1	Power Transfer	EPT-10		VD
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release exterior lever for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #003

Doors: CR1100-E

1	Continuous Hinge	661HD EPT x Sch Option	AL	ST
1	Exit Device	AX RX LD EL 35AL-NL SNB	628	VD

1	Cylinder Core	20-740 Primus Core	626	SC
1	Rim Cylinder Housing	20-079	626	SC
1	Door Closer	4111EDA x Drop plate as required	689	LC
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Door Sweep	345CNB		PE
1	Threshold	Per Detail x SS	US32D	PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #004

Doors: 1250B

NOTE: All hardware provided by door manufacturer.

SET #005

Doors: 1300B

2	Continuous Hinges	653 EPT Prep	US32D	ST
1	Concealed Exit Device	AX RX LD 98EO SNB	628	VD
1	Concealed Exit Device	AX RX LD EL 98L-NL SNB	628	VD
1	Removable Mullion	KR9954 10’0”	689	VD
2	Cylinder Core	20-740 Primus Core	626	SC
1	Rim Cylinder Housing	20-079	626	SC
1	Mortise Cylinder Housing	26-064	626	SC
2	Door Closer	4111HEDA	689	LC
2	Armor Plate	K1050 Height 36" x 2.5" LDW x CSK B3E	US32D	RO
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Base Stop	1475	626	DJ
2	Perimeter Seal	2891AS @ Head		PE
2	Perimeter Seal	2891AS @ Mullion		PE
2	Perimeter Seal	290AS @ Jambs		PE
2	Stainless Steel Threshold	Per Detail x SS 42”	US32D	PE
2	Brush Sweep	345CNB 42”		PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Power Supply	By Security		
2	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #006

Doors: CR0100C-A

1	Continuous Hinges	661HD EPT x Sch Option	AL	ST
1	Continuous Hinges	661HD Sch Option	AL	ST
1	Exit Device	AX RX LD 98EO SNB	628	VD
1	Exit Device	AX RX LD EL 98L-NL SNB	628	VD
1	Removable Mullion	KR9954 10’0”	689	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Mortise Cylinder Housing	26-064	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Base Stop	1475	626	DJ
1	Perimeter Seal	2891AS @ Head		PE
2	Perimeter Seal	2891AS @ Mullion		PE
2	Perimeter Seal	290AS @ Jambs		PE
2	Door Sweep	345CNB		PE
1	Stainless Steel Threshold	Per Detail x SS	US32D	PE
1	Drip Cap	346C 4” ODW		PE
2	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Power Supply	By Security		
2	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #007

Doors: 1ST 04, 2ST 04, 3ST 04, 4ST 04

1	Continuous Hinge	661 EPT HD x Sch Option	AL	ST
1	Exit Device	AX RX LD EL 98L-NL SNB	628	VD
1	Cylinder Core	20-740 Primus Core	626	SC
1	Rim Cylinder Housing	20-079	626	SC
1	Door Closer	4111EDA	689	LC
1	Base Stop	1475	626	DJ
1	Perimeter Seal	2891AS @ Head		PE
2	Perimeter Seal	290AS @ Jambs		PE
1	Door Sweep	345CNB		PE
1	Stainless Steel Threshold	Per Detail x SS	US32D	PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #008

Doors: CR0100-C, CR1100-B

2	Continuous Hinge	661HD EPT x Sch Option	AL	ST
2	Exit Device	AX RX LD EL 35A-L SNB	628	VD
1	Removable Mullion	KR9954 8’0”	689	VD
2	Rim Cylinder Housing	20-079	626	SC
1	Mortise Cylinder Housing	26-064	626	SC
3	Cylinder Core	20-740 Primus Core	626	SC
2	Auto Operators	9540 Push Side	689	LC
2	Base Stop	1475	626	DJ
1	Weatherstrip	By Alum. Storefront Mfg.		
2	Door Sweep	345CNB		PE
2	Stainless Steel Threshold	Per Detail x SS	US32D	PE
2	Power Transfer	EPT-10		VD
2	Bollard	BPS SM PRP36 CL	AL	WK
4	Push Pad	I36-5	AL	WK
1	Power Supply	PS914-4R (for latch retraction)		VD
1	Power Supply	By Security		
2	Door Contacts	By Security (as required)		
2	Card Readers	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch and initiate auto operator for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #009

Doors: 3111, 3111A

1	Continuous Hinge	661	AL	ST
1	Exit Device	AX 35A-L SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Base Stop	1475	626	DJ
1	Door Sweep	345CNB		PE
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Door Bottom	Per Detail		PE
1	Threshold	Per Detail	AL	PE
1	Door Contacts	By Security (as required)		

NOTE: Integrate door monitoring into security system as required.

SET #010 - Roof

Doors: RST 01, R202

1	Continuous Hinge	661HD x Sch Option	AL	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Base Stop	1475	626	DJ

1	Perimeter Seal	2891AS @ Head		PE
2	Perimeter Seal	290AS @ Jambs		PE
1	Door Sweep	345CNB		PE
1	Threshold	Per Detail	AL	PE
1	Drip Cap	346C 4” ODW		PE

SET #011

Doors: Not Used

1	Continuous Hinge	661HD x Sch Option	AL	ST
1	Exit Device	AX 35A-L-NL	628	VD
1	Cylinder Core	20-740 Primus Core	626	SC
1	Rim Cylinder Housing	20-079	626	SC
1	Door Closer	4111EDA x Drop plate as required	689	LC
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Door Sweep	345CNB		PE
1	Threshold	Per Detail	AL	PE
1	Door Contacts	By Security (as required)		

NOTE: Integrate door monitoring into security system as required.

SET #012

Doors: 1300A

1	Continuous Hinge	661HD EPT x Sch Option	AL	ST
1	Exit Device	AX RX LD EL 98L-NL SNB	628	VD
1	Cylinder Core	20-740 Primus Core	626	SC
1	Rim Cylinder Housing	20-079	626	SC
1	Door Closer	4111EDA	689	LC
1	Perimeter Seal	2891AS @ Head		PE
2	Perimeter Seal	290AS @ Jambs		PE
1	Door Sweep	345CNB		PE
1	Threshold	Per Detail	AL	PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #100

Doors: OST 01A

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	AX RX LD EL 98L-NL-F SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Wall Bumper	1270CX	626	TR
2	Perimeter Seal	290AS @ Head and Jambs		PE

1	Threshold	Per Detail	AL	PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Card Reader	By Security		
1	Door Contacts	By Security (as required)		
1	Power Supply	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #101

Doors: 0101A, 0103A

2	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Electric Hinge	CE FBB168 4 1/2 x 4 1/2 58 x JB-2R	652	ST
1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Floor Stop	1214	626	TR
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
3	Silencers	1229A		TR
1	Power Supply	By Security		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #102

Doors: 0101B, 0103B

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Pull w/ Plate	7016	630	DJ
1	Push Plate	70	630	DJ
1	Door Closer	4011EDA	689	LC
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Floor Stop	1214	626	TR

SET #103

Doors: 0101C

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Mop Plate	K1050 6" x 1" LDW x CSK B3E	US32D	RO
1	Wall Bumper	1270CX	626	TR
1	Threshold	Per Detail	AL	PE
3	Silencers	1229A		TR

SET #104

Doors: 1110A

3	Hinges	FBB179 4 1/2 x 4 1/2	652	ST
1	Passage Set	ND80-J RHO	626	SC
1	Wall Bumper	1270CX	626	TR
3	Silencers	1229A		TR

SET #105

Doors: 1101, 1232, 2101, 2207, 3101, 3207, 4101

3	Hinges	FBB179 4 1/2 x 4 1/2	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Wall Bumper	1270CX	626	TR
3	Silencers	1229A		TR

SET #106

Doors: 0105, 0106E, 0106F, 0106G, 0106H, 0107, 0130, 0140B, 0140C, 0142, 0204, 0206, 0207A, 0208, 0209, 236, 0240 – Hold Rooms

1	Continuous Hinge	653 CE600-8	US32D	ST
1	Electro-Mech Lock	L9092EU-J-T RX x 06A	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		
1	Door Contacts	By Security (as required)		
1	Power Supply	By Security		
1	Junction Box	By Electrical		
1	Card Reader	By Security		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #107

Doors: 0106, 0106A, 0106B, 0106C, 0106D, 0140A, 0246, 0248

1	Continuous Hinge	653	US32D	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SHCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #108

Doors: 0140

1	Continuous Hinge	653 CE600-8	US32D	ST
1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		
1	Door Contacts	By Security (as required)		
1	Power Supply	By Security		
1	Junction Box	By Electrical		
1	Card Reader	By Security		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #109

Doors: 0135

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Office Lockset	L9050-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Floor Stop	1211	626	TR
3	Silencers	1229A		TR

SET #110

Doors: 0137

2	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Electric Hinge	CE FBB168 4 1/2 x 4 1/2 58 x JB-2R	652	ST
1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Floor Stop	1214	626	TR
3	Silencers	1229A		TR
1	Threshold	Per Detail	AL	PE
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #111

Doors: 0132, 0136, 0138, 0140D - Procedures

1	Continuous Hinge	653	US32D	ST
1	Classroom Lock	L9071-J-T x 06A	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SHCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #112

Doors: 0139, 0205A, 0205B

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Privacy Set	L9040 x 06A	626	SC
1	Door Closer	4011EDA	689	LC
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Floor Stop	1211	626	TR
1	Threshold	Per Detail	AL	PE
3	Silencers	1229A		TR

SET #113

Doors: 0244A, 0244B, 0244C, 0250

1	Continuous Hinge	653	US32D	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB	PE	

SET #114

Doors: 0144A, 0144B

2	Continuous Hinge	653	US32D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office-A Lockset	L9050-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111SHCUSH	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #115

Doors: 0205C

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Office-A Lockset	L9050-J-T x 06A	626	SC

1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Floor Stop	1211	626	TR
3	Silencers	1229A		TR

SET #116

Doors: 0212B, 0238, 0244

1	Continuous Hinge	653 CE600-8	US32D	ST
1	Continuous Hinge	653	US32D	ST
1	Coordinator	3094 Series x Filler Bar		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office-A Lockset	L9050-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Electric Strike	6223 24VDC SO24	US32D	VD
2	Auto Operators	9550 Push Side	AL	VD
1	Wireless Receiver	Rec1Channel Receiver		WK
2	Push Pad	I36-5	AL	WK
2	Wireless Transmitter	SWTRAN 868 Transmitter		WK
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
2	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Wall plate actuators to signal operators to release electric strike and power open doors.

SET #117

Doors: 0212C

1	Continuous Hinge	653	US32D	ST
1	Passage Set	L9010 x 06A	626	SC
1	Door Closer	4111SHCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #118

Doors: 0234

2	Continuous Hinge	653 CE600-8	US32D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111SHCUSH	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO

1	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		
1	Power Supply	By Security		
2	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #119

Doors: 0213A, 0213B

2	Continuous Hinge	653	US32D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Storeroom Lock	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111HEDA	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB	PE	

SET #120

Doors: 0216

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Floor Stop	1214	626	TR
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #121

Doors: 0218, 0242C

1	Continuous Hinge	653	US32D	ST
1	Office-A Lockset	L9050-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SHCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 Height 10" x 2.5" LDW x CSK B3E	US32D	RO
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #122

Doors: 222

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SHCUSH	689	LC
3	Silencers	1229A		TR

SET #123

Doors: 220, 0226

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
3	Silencers	1229A		TR

SET #124

Doors: 302

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Office Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
3	Silencers	1229A		TR

SET #125

Doors: 0224

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SHCUSH	689	LC
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #126

Doors: 0242A, 0242B

2	Continuous Hinge	653	US32D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office-A Lockset	L9050-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111SHCUSH	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Armor Plate	K1050 Height" x 2.5" LDW x CSK B3E	US32D	RO
2	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #127

Doors: CR0100C4

2	Continuous Hinge	653	US32D	ST
1	Coordinator	3094 Series x Filler Bar		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	L9050-J-T x 06A x 10-072 7/8”	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 Height 10" x 2.5" LDW x CSK B3E	US32D	RO
2	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #128

Doors: 0104

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Wall Bumper	1270CX	626	TR
1	Door Sweep	345CNB	PE	
3	Silencers	1229A		TR

SET #129

Doors: DP6 1207, 1213

1	Continuous Hinge	653	US32D	ST
1	Office-A Lockset	ND60-J-T x RHO	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111HEDA	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Gasketing	S88D	BLK	PE

SET #130

Doors: DP6 1253

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	98L-NL-F CDSNB	628	VD
1	Rim Cylinder Housings	20-079	626	SC
1	Mortise Cylinder Housing	26-064	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Gasketing	S88D @ Head & Jambs		PE

SET #131

Doors: 0252

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC

1	Door Closer	4011EDA	689	LC
1	Floor Stop	1211	626	TR
3	Silencers	1229A		TR

SET #132

Doors: 0301, 0304

5	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Electric Hinge	CE FBB179 4 1/2 x 4 1/2 58 x JB-2R	652	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3810 X 3810	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Electro-mech Lock	L9092EU-J-T RX x 06A x 10-072 7/8”	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111SCUSH	689	LC
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Astragal	357P (Pull side active leaf)		PE
1	Gasketing	S88D @ Head & Jambs		PE
1	Gasketing	S88D @ Astragal		PE
1	Power Supply	By Security		
2	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #133

Doors: 0304A

6	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
2	Exit Device	98L-NL-F SNB	628	VD
1	Removable Mullion	KR9954 8’0”	689	VD
2	Rim Cylinder Housing	20-079	626	SC
1	Mortise Cylinder Housing	26-064	626	SC
3	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closers	4111SCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs		PE
1	Gasketing	S88D @ Mullion		PE

SET #134

Doors: 0304C2

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs		PE

SET #135

Doors: 4220, 0304B1, 0304B2

4	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	98L-NL-F SNB	628	VD
1	Rim Cylinder Housings	20-079	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs		PE

SET #136

Doors: 0304C1

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	AX 98L-NL SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Floor Stop	1211	626	TR
3	Silencers	1229A		TR

SET #137

Doors: CR0100B1

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	AX 98L-NL SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Door Contacts	By Security (as required)		

NOTE: Integrate door monitoring into security system as required.

SET #138

Doors: 0254

8	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3810 X 3810	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Passage Set	L9010 x 06A	626	SC
2	Door Closer	4111SHCUSH	689	LC
2	Silencers	1229A		TR

SET #139

Doors: CR0100A1, CR0200B

2	Continuous Hinge	661HD x Sch Option	AL	ST
2	Exit Device	AX 9847L LB SNB	628	VD
2	Rim Cylinder Housings	20-079	626	SC
3	Cylinder Cores	20-740 Primus Core	626	SC
2	Door Closers	4111FL (Fusible Link Arm)	689	LC

4	Silencer	1229A		TR
1	Door Contacts	By Security (as required)		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Integrate door monitoring into security system as required.

SET #140

Doors: CR0200A, CR0100B2

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	AX 98L-BE SNB	628	VD
1	Door Closer	4111SCUSH	689	LC
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #141

Doors: CR0100C2, CR0200A1

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	98EO	626	SC
1	Door Closer	4111EDA	689	LC
1	Wall Bumper	1270CX	626	TR
1	Door Sweep	345CNB		PE
1	Seal | Silencer Set	By Door & Frame Mfg		

SET #142

Doors: 4138A

6	Hinges	FBB179 4 1/2 x 4 1/2	652	ST
1	Storeroom Lock	ND80-J x RHO	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Manual Flushbolt	W3913	626	TR
2	Wall Bumper	1270CX	626	TR
2	Silencers	1229A		TR

SET #143

Doors: 1ST 01, 1ST 03A, 1ST 03B, 2ST 01, 2ST 03, 3ST 01, 3ST 03, 4ST 01, 4ST 03

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	AX 98L-F SNB	628	SC
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Wall Bumper	1270CX	626	TR
1	Perimeter Seal	290AS @ Head and Jambs		PE

SET #144

Doors: 1201A, 1231A, 2235, 2236, 3235, 3236, 4235, 4236

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	AX RX EL 98-L-F SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Gasketing	S88D @ Head & Jambs		PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #145

Doors: 1103, 1105, 2103, 2105, 3103, 3105, 4103, 4105

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Deadbolt	B662-J-T	626	SC
2	Cylinder Cores	20-740 Primus Core	626	SC
1	Push Plate	70	630	DJ
1	Pull Plate	7016	630	DJ
1	Door Closer	4011EDA	689	LC
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Floor Stop	1211	626	TR
1	Door Toe Pull	StepNpull	626	SP
3	Silencers	1229A		TR

SET #146

Doors: 1104, 2104, 3104, 4104

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Privacy Set	ND40 x RHO	626	SC
1	Door Closer	4011EDA	689	LC
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Floor Stop	1211	626	TR
1	Threshold	Per Detail	AL	PE
3	Silencers	1229A		TR

SET #147

Doors: 1106

2	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Electric Hinge	CE FBB179R 4 1/2 x 4 1/2 58 x JB-2R	652	ST
1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Floor Stop	1211	626	TR
3	Silencers	1229A		TR

1	Power Supply	By Security
1	Door Contacts	By Security (as required)
1	Card Reader	By Security
1	Junction Box	By Electrical
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #148

Doors: 0228, 1107

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111HCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs		PE
1	Bumper Seal Threshold	2010APK	AL	PE

SET #149 - Glass | CR

Doors: 1110C

1	Door Contacts	By Security (as required)
1	Power Transfer	As required
1	Power Supply	By Security
1	Card Reader	By Security
1	Junction Box	By Electrical
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES

NOTE: Card reader to unlock door for authorized access. Integrate door monitoring into security system as required. NOTE: Balance of hardware provided by glass door supplier.

SET #150

Doors: 1126, 2112

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Office Lockset	L9056-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Wall Bumper	1270CX	626	TR
1	Perimeter Seal	by Frame Manufacturer		PE
1	Auto Door Bottom	335N		PE
1	Threshold	Per Detail	AL	PE

SET #151

Doors: 1130, 1132, 1134, 1136, 1138, 2116, 2118, 2120, 2122, 2124, 2125, 2126, 2127, 2129, 2130, 2131, 2133, 2135, 2139, 3114, 3116, 3118, 3120, 3122, 3124, 3125, 3126, 3127, 3128, 3129, 3130, 3131, 3132, 3133, 3134, 3135, 3136, 3139, 3140, 4114, 4116, 4118, 4120, 4122, 4124, 4125, 4126, 4127, 4128, 4129, 4130, 4131, 4132, 4133, 4134, 4135, 4136, 4139, 4140 - DP6 1221, 1223, 1225, 1227, 1241, 1243, 1245, 1247

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Office Lockset	ND53-J-T x RHO	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Wall Bumper	1270CX	626	TR
1	Gasketing	By Alum. Frame Mfg.		

NOTE: Provide custom strike as required for frame condition.

SET #152

Doors: 1201

2	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Electric Hinge	CE FBB168R 4 1/2 x 4 1/2 58 x JB-2R	652	ST
1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Gasketing	S88D @ Head & Jambs	PE	
1	Wall Bumper	1270CX	626	TR
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #153

Doors: 1202, 2202, 3202, 4202

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	RX EL 98L-NL-F SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs		PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #155

Doors: Not Used

2	Continuous Hinge	653	US32D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	L9050-J-T x 06A x 10-072 7/8”	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Magnetic Holder	2100	US32D	AB
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Astragal	355S	AL	PE
1	Gasketing	S88D @ Head & Jambs		PE

NOTE: Integrate magnetic holders into fire alarm system.

SET #156

Doors: 1204A, 1204D, 1204E, 1204F, 1208A, 1208D, 1212A, 1212B, 2204A, 2204D, 2204F, 2204G, 2205A, 2205E, 2208B, 2208D, 2209B, 2209C, 2209D, 2209F, 2209G, 2212A, 2212B, 2212E, 2213A, 2213B, 2213C, 2213D, 2216, 2218, 3204A, 3204D, 3204F, 3204G, 3205A, 3208B, 3208D, 3209B, 3209C, 3209D, 3209F, 3209G, 3212A, 3212B, 3212E, 3213A, 3213B, 3213C, 3213D, 3214, 3216, 3250D, 4204A, 4204D, 4204F, 4204G, 4205A, 4205E, 4208B, 4208D, 4209B, 4209C, 4209D, 4209F, 4209G, 4212A, 4212B, 4212E, 4213A, 4213B, 4213C, 4213D, 4214, 4216 – DP6 1203, 1211A, 1211B, 1211C, 1229B, 1229C, 1229D, 1231B, 1231C, 1235

1	Continuous Hinge	653	US32D	ST
1	Office-A Lockset	ND60-J-T x RHO	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111HEDA	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
3	Silencers	1229A		TR

SET #156.1

Doors: 1233, 1239

1	Continuous Hinge	653	US32D	ST
1	Office-A Lockset	ND60-J-T x RHO	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111HEDA	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Gasketing	S88D @ Head & Jambs	PE	
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
3	Silencers	1229A		TR

SET #157

Doors: 1216, 1230

2	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Electric Hinge	CE FBB1681R 4 1/2 x 4 1/2 58 x JB-2R	652	ST

1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA/411EDA as needed	689	LC
1	Wall Bumper	1270CX	626	TR
1	Gasketing	S88D @ Head & Jambs		PE
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Power Supply	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #158

Doors: CR1100BA, CR1100C, CR1100D, CR2100B, CR2100C, CR2200C, CR3100C, CR3200C, CR4100B, CR4100C, CR4200C, 3100B

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	AX 98L-NL-F	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4011EDA	689	LC
1	Wall Bumper	1270CX	626	TR
1	Gasketing	S88D @ Head & Jambs		PE

SET #159

Doors: DP-6 1251

3	Hinges	FBB179 4 1/2 x 4 1/2	652	ST
1	Passage Set	L9010 x 06A	630	SC
1	Door Closer	4011EDA	689	LC
1	Wall Bumper	1270CX	626	TR

SET #160

Doors: 1210A, 2210A, 3210A, 4210A

1	Continuous Hinge	653	US32D	ST
1	Office-A Lockset	L9050-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Wall Bumper	1270CX	626	TR
1	Gasketing	S88D @ Head & Jambs		PE

SET #161

Doors: 1210B, 2210B, 3210B, 4210B

2	Continuous Hinge	653 CE600-8	US32D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR

1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Electro-mech Lock	L9092EU-J-T RX x 06A x 10-072 7/8”	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111SCUSH	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Astragal	355S	AL	PE
1	Gasketing	S88D @ Head & Jambs		PE
1	Power Supply	By Security		
2	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #162

Doors: 1212C

2	Continuous Hinge	653	US32D	ST
1	Set Auto Flush Bolts	3820 X 3810	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office-A Lockset	L9050-J-T x 06A	630	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SHCUSH	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO

NOTE: Closer on active leaf only.

SET #163

Doors: CR1100BB, 1208, 2208A, 2209, 3208, 3209, 4208, 4209

1	Continuous Hinge	653 EPT Prep	US32D	ST
1	Exit Device	AX RX LD EL98L-NL-F SNB	628	VD
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Gasketing	S88D @ Head & Jambs		PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #164

Doors: 1214, 1244, 2219, 3217, 4217

1	Continuous Hinge	653	US32D	ST
1	Exit Device	99L-F LD	626	SC
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Gasketing	S88D @ Head & Jambs		PE

SET #165

Doors: 1220

3	Hinges	FBB168 4 1/2 x 4 1/2 NRP	652	ST
1	Office Lockset	L9050-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Floor Stop	1214	626	TR
1	Gasketing	S88D @ Head & Jambs		PE

SET #166 - Glass

Doors: 1236A, 1236B, 1236C, 2235A, 2235B, 2235C, 2235D, 2236A, 2236B, 2236C, 2236D, 3235A, 3235B, 3235C, 3235D, 3236A, 3236B, 3236C, 3236D, 4235A, 4235B, 4235C, 4235D, 4236A, 4236B, 4236C, 4236D, DP6 1215, 1219, 1255B, 1255C, 1255D

NOTE: All hardware provided by glass door mfg.

SET #167

Doors: CR2200B, CR3200B, CR4200B

2	Continuous Hinge	653	US32D	ST
2	Exit Device	AX 9827L-F LB SNB	628	VD
2	Rim Cylinder Housings	20-079	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Magnetic Holder	2100	US32D	AB
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Gasketing	S88D @ Head & Jambs	PE	

SET #168

Doors: CR2200A, CR3200A, CR4200A

2	Continuous Hinge	653	US32D	ST

2	Exit Device	AX 9827L-F LB SNB	628	VD
2	Rim Cylinder Housings	20-079	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
2	Electric Closer Holder	4040SE 120V	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Gasketing	S88D @ Head & Jambs		PE

SET #169

Doors: 1250A

1	Continuous Hinge	653 CE600-8	US32D	ST
1	Electro-mech Lock	L9092EU-J-T RX x 06A	630	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Perimeter Seal	290AS @ Jambs		PE
1	Perimeter Seal	2891AS @ Head		PE
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #170

Doors: CR1100A, CR2100A, CR3100A, CR4100A

2	Continuous Hinge	661HD EPT	AL	ST
2	Exit Device	AX RX LD EL 9847L-NL-F SNB	626	VD
2	Rim Cylinder Housings	20-079	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111SCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs		PE
2	Power Transfer	EPT-10		VD
1	Power Supply	PS914-4R (for latch retraction)		VD
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release levers for authorized access.
NOTE: Integrate door monitoring into security system as required.

SET #171

Doors: CR1200, CR2200, CR3200, CR4200

2	Continuous Hinge	661HD	AL	ST
2	Exit Device	AX 9827L-F LB SNB	626	VD
2	Rim Cylinder Housings	20-079	626	SC

2	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111SCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs	PE	

SET #172

Doors: 2106, 3106, 4106

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Classroom Lockset	ND60-J-T x RHO	626	SC
2	Cylinder Core	20-740 Primus Core	626	SC
1	Wall Bumper	1270CX	626	TR
3	Silencers	1229A		TR

SET #173

Doors: 2201, 3201, 4201

2	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Electric Hinge	CE FBB179 4 1/2 x 4 1/2 58 x JB-2R	652	ST
1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs		PE
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #173.1

Doors: 1255A

2	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Electric Hinge	CE FBB179 4 1/2 x 4 1/2 58 x JB-2R	652	ST
1	Electro-mech Lock	L9092EU-J-T RX x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111	689	LC
1	Gasketing	S88D @ Head & Jambs		PE
1	Wall Bumper	1270CX	626	TR
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #174

Doors: 2217, 2220, 2221, 2225, 2227, 3215, 3218, 3219, 3223, 3225, 4215, 4218, 4219, 4223, 4225

1	Continuous Hinge	653	US32D	ST
1	Office-A Lockset	ND53-J-T x RHO	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111EDA	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Wall Bumper	1270CX	626	TR
1	Gasketing	S88D @ Head & Jambs		PE

SET #175

Doors: 1246, 2229, 3227, 4227

1	Continuous Hinge	653	US32D	ST
1	Storeroom Lockset	L9080-J-T x 06A	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Gasketing	S88D @ Head & Jambs		PE

SET #176

Doors: 2231, 3229, 4229

2	Continuous Hinge	653	US32D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3810 X 3810	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	L9050-J-T x 06A x 10-072 7/8”	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Astragal	357P		PE
1	Gasketing	S88D@ Astragal		PE
1	Gasketing	S88D@ Head & Jambs		PE

SET #177

Doors: 2235E, 3235E, 4235E

3	Hinges	FBB179 4 1/2 x 4 1/2 NRP	652	ST
1	Exit Device	AX 98 L-F SNB	626	SC
1	Door Closer	4111SCUSH	689	LC
1	Gasketing	S88D @ Head & Jambs		PE

SET #178

Doors: 2209J, 3209J, 4209J

1	Continuous Hinge	653	US32D	ST
1	Exit Device	AX 98L-F SNB	628	
1	Rim Cylinder Housing	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
1	Door Closer	4111HEDA	689	LC
1	Half Edge Guard	305 C/O x Full Height	US32D	RO
1	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
1	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
3	Silencers	1229A		TR

SET #179

Doors: CR0200A2

1	Continuous Hinge	653 EPT Prep	US32D	ST
1	Continuous Hinge	653	US32D	ST
1	Exit Device	AX RX LD EL 9847L-NL LB SNB	628	VD
1	Exit Device	AX RX LD 9847EO LB SNB	628	VD
1	Rim Cylinder Housings	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closers	4111FL (Fusible link arms)	689	LC
1	Gasketing	S88D @ Head & Jambs		PE
2	Door Sweep	345CNB		PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
2	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Local Alarm	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access. Integrate door monitoring into security system as required.

SET #180

Doors: 1204, 1209C, 1209D, 1212, 2204, 2205, 2212, 2213, 3204, 3205, 3212, 3213, 4204, 4205, 4212, 4213

2	Continuous Hinge	653	US32D	ST
1	Exit Device	9827-LF x 996L x LB SNB	628	VD
1	Exit Device	9827-EO-F LB SNB	628	VD
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Magnetic Holder	2100	US32D	AB
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Meeting Stile Seal	S773		PE
1	Gasketing	S88D @ Head & Jambs		PE
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Integrate magnetic holders into fire alarm system.

SET #180.1

Doors: 1209B

1	Continuous Hinge	653 EPT Prep	US32D	ST
1	Continuous Hinge	653	US32D	ST
1	Exit Device	EL 9827-LF x 996L x LB SNB	628	VD
1	Exit Device	9827-EO-F LB SNB	628	VD
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Magnetic Holder	2100	US32D	AB
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Meeting Stile Seal	S773		PE
1	Gasketing	S88D @ Head & Jambs		PE
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Integrate magnetic holders into fire alarm system.

SET #181

Doors: 1240A

2	Continuous Hinge	653	US32D	ST
2	Exit Device	9847L-F LB SNB	628	VD
2	Rim Cylinder Housings	20-079	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Gasketing	S88D @ Head & Jambs		PE

SET #181.1

Doors: 1240B

2	Continuous Hinge	653	US32D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3810 X 3810	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	L9050-J-T x 06A x 10-072 7/8”	626	SC
1	Cylinder Core	20-740 Primus Core	626	SC
2	Door Closer	4111EDA	689	LC
2	Half Edge Guard	305 C/O x Full Height	US32D	RO
2	Kick Plate	K1050 10” x 2.5” LDW X CSK B3E	US32D	RO
2	Mop Plate	K1050 6” x 1” LDW x CSK B3E	US32D	RO
1	Gasketing	S88D @ Head & Jambs		PE

SET #182 - Glass

Doors: DP6 1201B, 1201C

1	Continuous Hinge	653 EPT HD x Sch Option	652	RX
1	Exit Device	EL RX LD 35A x L	628	VD
1	Concealed Closer	PH91	689	RX
1	Cylinder Core	20-740 Primus Core	626	SC
1	Power Transfer	EPT-10		VD
1	Power Supply	PS914 (for latch retraction)		VD
1	Power Supply	By Security		
1	Door Contacts	By Security (as required)		
1	Card Reader	By Security		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access.
NOTE: Integrate door monitoring into security system as required.

END OF SECTION

SECTION 08 7113 - AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Low-energy door operators for swinging doors.

B. Related Requirements:

1. Section 08 4229.33 "Swinging Automatic Entrances" for swinging doors and frames packaged with automatic door operators.

1.3 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. Double-Egress (Doors): A pair of doors that simultaneously swing with the two doors moving in opposite directions with no mullion between them.

D. Double-Swing (Doors): A pair of doors that swing with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.

E. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

F. For automatic door terminology, see BHMA A156.19 for definitions of terms.

1.4 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified elsewhere.

B. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.

C. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.

D. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies and access-control system.

E. Pneumatic System Roughing-in: Coordinate layout and installation of automatic door operators and power units with compressed-air piping.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic door operators.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.

2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Indicate locations of activation and safety devices.

4. Include diagrams for power, signal, and control wiring.

5. Include plans, elevations, sections, and attachment details for guide rails.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project and who employs a Certified Inspector.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Certified Inspector Qualifications: Certified by AAADM.

C. Accessibility: Comply with requirements of the 2010 ADA Standards and 2013 CBC 11B.

D. Provide the following upon request:

1. Qualification Data: For Certified Inspector.

2. Product Certificates: For each type of automatic door operator.

3. Field quality-control reports.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty or sporadic operation of automatic door operator, including controls.

b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 AUTOMATIC DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and according to UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.

1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.

C. Hinges: See Section 08 7100 "Door Hardware" for hinge type for each door that door operator shall accommodate.

D. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch- thick, extruded or formed aluminum; continuous over full width of operator-controlled door opening; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.

E. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.

F. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 LOW-ENERGY DOOR OPERATORS

A. Standard: BHMA A156.19.

B. Performance Requirements:

1. Opening Force if Power Fails: Not more than 5 lbf required to release latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 5 lbf required to fully open door.
2. Entrapment-Prevention Force: Not more than 5 lbf required to prevent stopped door from closing or opening.
3. Comply with 2013 CBC 11B.309.4.

C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: Two way.
2. Operator Mounting: Surface.

D. Configuration: Operator to control pair of swinging doors.

1. Traffic Pattern: Two way.
2. Mounting: Surface.

E. Operation: Power opening and power-assisted spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

F. Operating System: Electromechanical.

G. Microprocessor Control Unit: Solid-state controller.

H. Features:

1. Adjustable opening and closing speed.
2. Adjustable opening and closing force.
3. Adjustable backcheck.
4. Adjustable hold-open time from zero to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Obstruction recycle.
8. On-off/hold-open switch to control electric power to operator; key operated.

I. Activation Device: Hi-Lo Push-plate switches or push bar to activate door operator.

J. Exposed Finish: Finish matching door and frame.

2.3 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.

2. Sheet: ASTM B 209.

B. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.4 CONTROLS

A. General: Provide controls, including activation and safety devices, according to BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

B. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

C. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.

1. Configuration: Square push plate with 4-by-4-inchjunction box.

a. Mounting: As indicated on Drawings .

2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.

3. Message: International symbol of accessibility and "Push to Open."

D. Push Bar Switch: Momentary-contact door control with vertical bar actuator complying with CBC 11B requirements.

1. Push-Plate Material: Stainless steel

2. Message: International symbol of accessibility and "Push to Open."

E. Key Switch: Recess-mounted, door control switch with key-controlled actuator; enclosed in 2-by-4-inch junction box. Provide faceplate engraved with text indicating switch functions.

1. Faceplate Material: Stainless steel as selected by Architect from manufacturer's full range.

2. Functions: Two-way automatic, hold open, one-way exit, off, full open, and partial open.

3. Mounting: As indicated on Drawings.

F. Provide a fire alarm interface relay. Coordinate with fire alarm system installer.

G. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.5 FABRICATION

A. Factory fabricate automatic door operators to comply with indicated standards.

B. Form aluminum shapes before finishing.

C. Fabricate exterior components to drain condensation and water passing joints within operator enclosure to the exterior.

D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

E. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

2.6 ACCESSORIES

A. Signage: As required by cited BHMA standard for type of door and its operation.

1. Application Process: Operator manufacturer's standard process.

2. Provide sign materials with instructions for field application when operators are installed.

2.7 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.

C. Examine roughing-in for compressed-air piping systems to verify actual locations of piping connections before automatic door operator installation.

D. Verify that full-height finger guards are installed at each door with pivot hinges where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install automatic door operators according to manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.

1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.

2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.

B. Controls: Install activation and safety devices according to manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. Access-Control System: Connect operators to access-control system as specified in Section 28 1300 "Access Control."

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 FIELD QUALITY CONTROL

A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic door operators will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust operators on exterior doors for weathertight closure.

B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.

C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic door operator Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.

2. Perform maintenance, including emergency callback service, during normal working hours.

3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators.

END OF SECTION

SECTION 08 8000 – GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors.
2. Glazed curtain walls.
3. Storefront framing.
4. Glazed entrances.
5. Sloped glazing.
6. Interior borrowed lites.

B. Related Sections:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 05 7300 "Decorative Metal Railings" for glass panels in railings.
3. Section 08 4126 "All-Glass Entrances and Storefronts."
4. Section 08 4229.33 "Swinging Automatic Entrances."
5. Section 08 4413 "Glazed Aluminum Curtain Walls" for glazing sealants.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, as defined in referenced glazing publications.

B. Glass Fabrication: Using primary glass in the production of single pane glass products such as coated, laminated and heat treated glass. Can be done by either the Glass Manufacturer or the Glazing Product Manufacturer.

C. Glazing Product Manufacturer: Firm that uses fabricated glass in the production of insulating glass (multiple panes of glass).

1. Structural Glazing Product Manufacture: Firm that produces insulating glass for use in a structural glazing system.

D. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

E. Large Glass Lites and Insulating Glass Units: over 55 SF.

F. Interspace: Space between lites of a conventional insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.

2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

3. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:

a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.

b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.

c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.

4. Probability of Breakage:

a. For glass surfaces sloped no more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.008 (8 per 1000).

b. For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001 (1 per 1000).

5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal.

B. Product Data: For each glass product and glazing material indicated.

C. Shop Drawings:

1. Submit Shop Drawings of glazing details. Draw details at least full size (twice full size preferred) and indicate dimensions, tolerances and materials.
2. Submit Shop Drawings for structural sealant glazing after review and approval of Shop Drawings by sealant and glass product manufacturers.

D. LEED Submittals:

1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
2. Product Data for Credit MR 4: Recycled content
3. Product Data for Credit MR 5: Regional Materials

E. Glass Samples: With each submittal, submit a list of all glass Styles required in the Project. On the list, indicate which Styles are included in the submittal.

1. Each style of monolithic and laminated glass, except clear monolithic glass, no less than 75 by 150 mm (3 by 6 inches).
2. Each style of insulating and insulating laminated glass unit, no less than 300 by 300 mm (12 by 12 inches), including type of edge seal, spacer, and corner construction of spacer. Identify specific type of reflective and low-emissivity coated glasses, coated surfaces, and exterior face of unit.

3. Each style of spandrel glass, no less than 300 by 300 mm (12 by 12 inches).

F. Exposed Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system after sealant color selection has been made.

G. Other Glazing Accessory Samples:

1. Corner construction of compression gasket for dry glazing with each leg approximately 150 mm (6 inches) long.
2. Tape sealant, 150 mm (6 inches long).
3. Compression wedge, 150 mm (6 inches) long.
4. Channel gasket, 150 mm (6 inches) long.
5. Bed gasket, 150 mm (6 inches) long.
6. Face shim or spacer.
7. Setting block.
8. Edge block.
9. Compressible filler.
10. Open cell filter.

H. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

I. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

J. Qualification Data: For installers manufacturers of insulating-glass units with sputter-coated, low-e coatings glass testing agency and sealant testing agency.

K. Product Certificates:

1. For exterior glazing, Glass Fabrication manufacturer's statement that products meet the specified glass breakage probability requirements for indicated applied loads, that expected thermal stressing of products is acceptable and that glazing details (if required by Glass Fabrication manufacturer) have been reviewed and are approved.
2. Submit statement from Glazing Product Manufacturer stating that glazing products meet the requirements of the specified standards, the project specifications, and there is no incompatibility of glazing materials with the insulating glass unit sealants.
3. Submit statement from Structural Glazing Product Manufacturer indicating the following:
   a. The details of construction have been reviewed and are approved for use with the glass products.
   b. The secondary seal of insulating glass units has been designed and sized to resist the applied loads.

c. The Contractor's quality assurance program has been reviewed and is approved.

4. If any of the above required statements involve more than one manufacturer, submit certificates from each of those manufacturers.

L. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass insulating glass glazing sealants andglazing gaskets.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

M. Preconstruction adhesion and compatibility test report.

N. Quality Assurance Program (QAP)

1. Glass fabrication: Written QAP including but not limited to reference of applicable ASTM testing methodology, type and frequency of in-line monitoring of glass fabrication, and reporting and documentation. Test sample lite of glass, at GC's expense, for conformance to a) bow and warp, b) localized distortion / roller wave, c) concavity / convexity and d) compression strength.

2. Installation: Written QAP to monitor quality of products such as cleaners, solvents, primers, and sealants; and sealant workmanship including, cleaning, priming, joint opening preparation, and sealant installation.

a. Include as part of program random adhesion and compatibility testing of production run products.

b. Do not install sealant work prior to review of program.

c. Submit quality assurance program to glass and sealant manufacturers for review and approval prior to submission to Architect.

1.7 QUALITY ASSURANCE

A. Glazing Product Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1. Level 1 minimum: all installers

2. Level 2 minimum: on-site superintendents

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glass: Obtain fabricated glass from single source from single manufacturer using primary glass obtained from a single source for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1. All permanent marks and/or labels should be placed in the vicinity of the glass where the label is not obscured by the glass bite, gasket, sealant or other anchoring/glazing material. End text at least 3 mm from all site lines of the fenestration glazing to allow for readability.

I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Glazing mock-up: Produce three full-sized IGUs for review and approval by the Architect before full production run.
2. Install glazing in mockups specified in Division 08 Section "Aluminum-Framed Entrances and Storefronts Glazed Aluminum Curtain Walls " to match glazing systems required for Project, including glazing methods.
3. Approved sample installation may become part of the completed Work if undisturbed at time of Substantial Completion.

4. Place mockup where reflection from adjacent buildings or other structures with a regular pattern can be used to gauge overall appearance / distortion of the glass.

5. Comply with Section 01 4339 "Exterior Walls Mockups".

L. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Review temporary protection requirements for glazing during and after installation.

3. Include with preinstallation conferences those glazing systems listed in Summary 1.2.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F. Do not install sealants to wet or frost covered surfaces.

1.10 WARRANTY

A. General: During the warranty period, restore defective Work to the standard of the Contract Documents, including all labor, materials, refinishing and other costs incidental to the Work. Restore Work found to be defective as defined in the Contract Documents.

B. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Includes but not limited to fused ceramic spandrel, low-emissivity, and reflective glass.

2. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Includes but not limited to opacified spandrel glass.

2. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

E. Manufacturer's Special Warranty on Fire-resistant Glass: Manufacturer's standard form in which Fire-resistant glass manufacturer agrees to replace insulating-glass if vision through the unit being adversely affected.

1. Warranty Period: 10 years from date of Substantial Completion.

F. Installation: Glazing systems installation shall be warranted for a period of 5 years against defective materials and workmanship.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass and Kind HS heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass as needed to comply with "Performance Requirements" Article. For life safety or fire knock-out panel considerations, where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

D. Safety Glass

1. CPSC 16 CFR part 1201, testing requirements of ANSI Z97.1, and listed in the SGCC Certified Products Directory with appropriate SGCC certification mark or label permanently affixed.
2. Furnish safety glass for glass occurring in doors and sidelights, and where indicated and further required by authorities having jurisdiction.

E. Sound Control Glass

1. Products with air borne sound transmission loss as measured by ASTM E90 and STC rating as classified by ASTM E413.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent[and solar heat gain coefficient not less than 0.87].

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. AFG Industries, Inc.; Krystal Klear.
   b. Guardian Industries Corp.; Ultrawhite.
   c. Pilkington North America; Optiwhite.
   d. PPG Industries, Inc.; Starphire.

C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2. For uncoated glass, comply with requirements for Condition A.

3. For coated vision glass, comply with requirements for Condition C (other coated glass).

4. Limit Kind HS surface compression to upper end of ASTM C 1048 range, 7,500 psi.

5. Distortion Tolerances:

   a. Roller Wave: Maximum 0.003 inch (0.076mm) from peak to valley within the main body of the sheet and maximum 0.008 inch (0.20mm) within 10.5 inches of a leading or trailing edge.

   b. Localized Warp: Maximum 0.03 inch (0.80mm) over any 12 inch (305mm) span, but limited to 0.31 inch (8.00mm).

D. Low E Coated Vision Glass: ASTM C 1376, coated by vacuum deposition (sputter-coating) process, and complying with other requirements specified.

~~?. <Insert manufacturer's name; product name or designation> or comparable product by one of the following:~~

1. Kind: Kind CV (coated vision glass)[, except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than 6 feet above the adjacent floor level or cannot be approached closer than 10 feet].

E. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.

1. Glass: Clear float.

2. Ceramic Coating Color: As selected by Architect from manufacturer's full range.

F. Low E Coated Spandrel Glass: ASTM C 1376, Kind CS; coated by vacuum deposition (sputter-coating) process, and complying with other requirements specified.

G. Mirror

1. Type I, Class 1, glass complete with silvering, copper coating, and protective organic coating; silvering of pure silver, in compliance with ASTM C1503; two-coat abrasion resistant baked on protective coating.

2.3 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with SentryGlas polymer interlayer to comply with interlayer manufacturer's written recommendations.

2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

3. Interlayer Color: Clear unless otherwise indicated.

B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.4 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Listed in the IGCC/IGMA Certified Products Directory with appropriate Certification mark on the spacer or at least one pane of unit.
2. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary, and with soldered, welded, and/or bent spacer corner construction..
3. Spacer: Stainless steel .
4. Color: Black.
5. Desiccant: Molecular sieve or silica gel, or blend of both.

B. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
5. Compression wedge for dry glazing system: of shape and size to compress the exterior compression gasket a minimum of 25 percent, and as recommended by glazing and sealing systems manufacturer.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Bed gasket for wet glazing system: continuous with pressure sensitive adhesive 1 side, designed to be compressed 25-40 percent in the opening.
2. Compression gasket for dry glazing system: shape as required to be compressed in place a minimum of 25 percent and of one-piece construction with factory-assembled frames with injection-molded, vulcanized corners; produced oversize in opening dimension, as determined by measurements, to insure compression at corners but within limits so that compression does not create a "pucker".

3. Channel gasket: continuous channel of shape and dimensions for application in the opening with specified glazing.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.

4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

a. Dow Corning Corporation; [756 SMS] [791] [795] [995].

b. GE Advanced Materials - Silicones; [SilGlaze II SCS2800] [SilPruf NB SCS9000] [SilPruf SCS2000] [UltraPruf II SCS2900].

c. Tremco Incorporated; [Spectrem 2] [Spectrem 3].

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.

2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

C. For openings up to 1900 united mm (75 united inches), use unshimmed tape. For openings over 1900 united mm (75 united inches), use pre-shimmed tape.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

1. Each block shall be properly sized for load, as wide or wider than glazing, no less than 100 mm (4 inches) long; profile to permit friction fit, dart insertion into metal chair, or pressure sensitive adhesive one side to fix block in glazing opening.

D. Spacers: Elastomeric blocks or continuous extrusions of 40 to 60 Shore "A" durometer hardness to maintain glass lites in place for installation indicated.

1. Profile to permit friction fit, dart insertion or pressure sensitive adhesive one side to fix shim or spacer in location.

E. Edge Blocks: Elastomeric material of 40 to 60 Shore "A" durometer hardness to limit glass lateral movement (side walking).

1. Each block shall be a minimum of 100 mm (4 inches) long, as wide as glazing, placed in the vertical glazing channel, and sized to allow a nominal 3-mm (1/8-inch) clearance between glass edge and installed block; profile to permit friction fit or pressure sensitive adhesive one side to fix block in glazing opening.

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Open Cell Filter

1. Reticulated flexible polyester urethane foam having 20 pores per inch, sized at least 25 mm (1 inch) larger in dimension than weephole, of cross section to provide 15 to 25 percent compression for friction fit and as manufactured by Foam Division, Scott Paper Co.; H-O Products Corp.; or as approved.

H. Bond breaker

1. Heavy duty, 0.28-mm (11-mil) minimum thickness, colored, polyethylene or teflon, self-adhesive bond breaker of type recommended by sealant manufacturer and suitable for conditions of usage. Liquid bond breaker is not permitted.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

D. Speaking holes 100 mm (4 inches) in diameter, unless otherwise indicated.

2.10 MONOLITHIC-GLASS TYPES

A. Glass Type : Clear heat-strengthened float glass fully tempered float glass.

1. Thickness: 6.0 mm.

2. Provide safety glazing labeling.

B. See Interior Finishes and Materials Legend on drawings.

C. Glass Type : Mirror

1. Thickness: [6.0 mm (1/4 inch)] <Insert thickness designation>.

2.11 LAMINATED-GLASS TYPES

A. See Interior Finishes and Materials Legend on drawings.

B. Glass Type [GL-19]: Clear laminated glass with two plies of ultraclear heat-strengthened float glass.

1. Thickness of Each Glass Ply: 6.0 mm .

2. Interlayer Thickness: 0.090 inch.

2.12 INSULATING-GLASS TYPES

A. Glass Types GL-11, GL-12. GL-13: Low-e-coated, clear insulating glass.

1. Overall Unit Thickness: 1 inch.

2. Thickness of Each Glass Lite: 6.0 mm.

3. Outdoor Lite: Heat-strengthened float glass, typical, except where required to be tempered per Article 2.1.D and CBC 2406.4. ~~(Fully tempered float glass where indicated).~~

4. Interspace Content: Air.
5. Indoor Lite: Heat-strengthened float glass (Fully tempered float glass where indicated).
6. Low-E Coating: Sputtered on second surface.
   a. Low E Coating Type: Solarban 70XL by PPG.
7. Acid Etch Basis of Design: Clear Walker Velour on #3 surface (GL-12 and GL-13 Only).
8. Visible Light Transmittance: 64 percent minimum.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Summer Daytime U-Factor: 0.26 maximum.
11. Solar Heat Gain Coefficient: 0.27 maximum.
12. Provide safety glazing labeling.

B. Glass Types GL-14 and GL-15.: Low-e-coated, clear insulating glass.

1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Heat-strengthened float glass (Fully tempered float glass where indicated).
4. Interspace Content: Air.
5. Indoor Lite: Heat-strengthened float glass (Fully tempered float glass where indicated).
6. Low-E Coating: Sputtered on second surface.
   a. Low E Coating Type: Solarban R100 by PPG.
7. Acid Etch Basis of Design: Clear Walker Velour on #3 surface (GL-15 Only).
8. Visible Light Transmittance: 42 percent minimum.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Summer Daytime U-Factor: 0.27 maximum.
11. Solar Heat Gain Coefficient: 0.23 maximum.
12. Provide safety glazing labeling.

2.13 INSULATING-LAMINATED-GLASS TYPES

A. Glass Types GL-16 and GL-17 : Low-e-coated, clear insulating laminated glass.

1. Overall Unit Thickness: 1-1/8 inch.
2. Thickness of Outdoor Lite: 6.0 mm.
3. Outdoor Lite: Heat-strengthened float glass.
4. Interspace Content: Air.
5. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.

a. Thickness of Each Glass Ply: *4.0 mm*.
b. Interlayer Thickness: 0.060 inch.

6. Low-E Coating: or Sputtered on second surface.
   a. Low E Coating Type: Solarban R100 by PPG.
7. Acid Etch Basis of Design: Clear Walker Velour on #3 surface (GL-17 Only)
8. Visible Light Transmittance: 42 percent minimum.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Summer Daytime U-Factor: 0.27 maximum.
11. Solar Heat Gain Coefficient: 0.23 maximum.
12. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
   1. Ensure approved Quality Assurance Program is implemented.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

1. Locate one quarter of glass width from each corner, but with block edge nearest corner no closer than 150 mm (6 inches) from corner, unless otherwise specified or required by glass manufacturer.

2. Insulating glass used in sloped glazing shall have both panes supported by setting blocks.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 08 9119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, formed-metal louvers.

B. Related Requirements:

1. Section 08 1113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
2. Section 08 1416 "Flush Wood Doors" for louvers in flush wood doors.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

D. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural[and seismic] performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

B. Provide the following upon request:

1. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

B. ~~30 feet~~Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

~~?. Air Balance Inc.; a Mestek company~~

~~?. 2 inches4 inches6 inches~~

~~?. 7.5 sq. ft. (0.70 sq. m)8.0 sq. ft. (0.74 sq. m)8.5 sq. ft. (0.79 sq.48-inch-48-inch-~~

~~?. Air Balance Inc.; a Mestek company~~

~~?. 4 inches6 inches~~

~~?. 7.0 sq. ft. (0.65 sq. m)7.5 sq. ft. (0.70 sq. m)8.0 sq. ft. (0.74 sq. m)8.5 sq. ft. (0.79 sq.48-inch-48-inch-~~

~~?. Airolite Company, LLC (The)~~

~~?. 6 inches~~

~~?. 7.8 sq. ft. (0.72 sq.48-inch-48-inch-~~

~~?. Air Balance Inc.; a Mestek company~~

~~?. 4 inches5 inches7 inches8 inches9 inches~~

~~?. 5.0 sq. ft. (0.46 sq. m)6.0 sq. ft. (0.56 sq. m)7.0 sq. ft. (0.65 sq.48-inch-48-inch-~~

~~?. Air Balance Inc.; a Mestek company~~

~~?. 4 inches6 inches8 inches9 inches12 inches~~

~~?. 5.0 sq. ft. (0.46 sq. m)6.0 sq. ft. (0.56 sq. m)7.0 sq. ft. (0.65 sq.48-inch-48-inch-~~

~~?. Air Balance Inc.; a Mestek company~~

~~?. 5 inches~~

~~?. 8.3 sq. ft. (0.77 sq.48-inch-48-inch-~~

~~?. Air Balance Inc.; a Mestek company~~

~~?. 4 inches~~

2.3 FIXED, FORMED-METAL LOUVERS

~~?. Air Balance Inc.; a Mestek company~~

~~?. 4 inches6 inches~~

~~?. 6.5 sq. ft. (0.60 sq. m)7.0 sq. ft. (0.65 sq. m)7.5 sq. ft. (0.70 sq. m)8.0 sq. ft. (0.74 sq.48-inch-48-inch-~~

B. Horizontal, Drainable-Blade Louver :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ~~Air Balance Inc.; a Mestek company~~Airolite Company, LLC (The).

b. American Warming and Ventilating; a Mestek company.

c. Construction Specialties, Inc.

d. Airline by Nystrom.

e. Ruskin Company; Tomkins PLC.

2. Louver Depth: ~~4 inches~~6 inches.

3. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.052 inch for frames and 0.040 inch for blades

4. Mullion Type: Exposed.

5. Louver Performance Ratings:

a. Free Area: Not less than ~~7.0 sq. ft. (0.65 sq. m)~~7.5 sq. ft. (0.70 sq. m)~~8.0 sq. ft. (0.74 sq. m)~~8.5 sq. ft. (0.79 sq. for 48-inch- wide by 48-inch- high louver.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

~~?. Air Balance Inc.; a Mestek company~~

~~?. 6 inches8 inches12 inches~~

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.

2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Same finish as louver frames to which louver screens are attached.

3. Type: Rewirable frames with a driven spline or insert.

~~?. 1/2-inch-0.063-inch~~

E. Louver Screening for Galvanized-Steel Louvers:

1. Bird Screening: Galvanized steel, 1/2-inch- square mesh, 0.041-inch wire.

~~?. 1/2-inch-0.047-inch~~

2.5 BLANK-OFF PANELS

A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.

1. ~~0.050-inch~~Galvanized-steel sheet for galvanized-steel louvers, not less than 0.040-inch ~~0.052-inch~~nominal thickness.

B. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 1 inch~~2 inches~~.
2. Metal Facing Sheets: Galvanized-steel sheet, not less than 0.028-inch nominal thickness.
3. Insulating Core: Rigid, glass-fiber-board insulation .
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard channel frames, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same type of finish applied to louvers, but black color.
7. Attach blank-off panels with sheet metal screws.

2.6 MATERIALS

A. ~~ASTM B 221~~Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

B. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.

C. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: ~~Channel~~ Exterior flange unless otherwise indicated.
2. Removable Louver: Where indicated, provide louver in subframe that is removable from exterior flanged frame.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide subsills made of same material as louvers for recessed louvers.

F. Join frame members to each other and to fixed louver blades with fillet **welds** , threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 GALVANIZED-STEEL SHEET FINISHES

A. Finish louvers after assembly.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 9200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

SECTION 09 0561.13 - MOISTURE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

B. Contractor's Responsibility: Suitability of concrete slab to meet vapor emission limits as required by scheduled floor finish materials is the responsibility of the Contractor. Where concrete slab vapor emission exceeds limits, apply topical vapor retarders specified in this section.

C. Related Requirements:

1. Section 03 3000 "Cast-in-Place Concrete" for concrete floor slabs.
2. Section 09 6513 "Resilient Base and Accessories."
3. Section 09 6516 "Resilient Sheet Flooring."
4. Section 09 6519 "Resilient Tile Flooring."
5. Section 09 6723 "Resinous Flooring."
6. Section 09 6813 "Tile Carpeting."

1.3 DEFINITIONS

A. MVE: Moisture vapor emission.

B. MVER: Moisture vapor emission rate.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For coatings, indicating VOC content.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

1.5 INFORMATIONAL SUBMITTALS

A. Certifications: Furnish written certification that the manufacturer has verified the compatibility between the vapor retarder provided and the flooring product scheduled to be applied, including adhesives and floor leveling materials.

B. Flooring Manufacturer Acceptance of Vapor Retarder Application: Furnish a signed written statement obtained from flooring manufacturer, stating that the water vapor emission levels, after application of vapor retarders, are acceptable and suitable for their flooring application.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

C. Provide the following upon request:

1. Qualification Data: For Installer and manufacturer.
2. Product Test Reports: For each MVE-control system, for tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency.
3. Preinstallation testing reports.
4. Field quality-control reports.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.

1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.
2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer and Installer agree to repair or replace the applied concrete vapor retarder, the new floor covering or coating, including materials and labor for applied concrete vapor retarder that fails to remain adhered to the substrate or is affected by moisture or alkalinity within the specified warranty period. Manufacturer's warranty requires manufacturer's inspection and written authorization, prior to removal of existing floor covering and applied concrete vapor retarder.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:

1. MVER: Maximum 25 lb of water/1000 sq. ft. when tested according to ASTM F 1869.

2. Relative Humidity: Maximum 100 percent when tested according to ASTM F 2170 using in situ probes.

C. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 permwhen tested according to ASTM E 96/E 96M.

D. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D 7234.

2.2 MVE-CONTROL SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advanced Moisture Control, Inc.

2. ARDEX Americas.

3. Dependable, LLC.

4. Floor Seal Technology, Inc.

5. KOSTER American Corporation.

6. MAPEI Corporation.

B. MVE-Control System: ASTM F 3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.

1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.

2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

2.3 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C 109/C 109M.

B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's hydraulic cement-based underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Preinstallation Testing:

1. Testing Agency: Engage a qualified testing agency to perform tests.

2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.

3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Internal Relative Humidity Test: Using in situ probes, ASTM F 2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.

4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. area of MVE-control system to prepared concrete substrate and test according to ASTM D 7234.
   a. Proceed with installation only where tensile bond strength is greater than 200 psi with failure in the concrete.

B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.

1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
5. Fill surface depressions and irregularities with patching and leveling material.
6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.3 INSTALLATION

A. General: Install MVE-control system according to ASTM F 3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.

1. Install primers as required to comply with manufacturer's written instructions.

B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.

E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.

F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform installation inspections.

B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.

1. Verify that surface preparation meets requirements.

2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.

3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.

C. MVE-control system will be considered defective if it does not pass inspections.

3.5 PROTECTION

A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.

B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION

SECTION 09 2116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

2. ~~Product Certificates: For materials manufactured within 100 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.~~

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.

B. Do not install finish panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES Insert drawing designation

A. Fire-Resistance Rating: As indicated.

B. STC Rating: As indicated.

C. Gypsum Shaftliner Board:

1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.

2. Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch thick, and with double beveled long edges.

3. Moisture- and Mold-Resistant, Fiberglass-Mat Faced: ASTM C 1658/C 1658M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch thick, and with double beveled long edges.

D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: ASTM A 653/A 653M, G60 , hot-dip galvanized unless otherwise indicated.

E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As indicated.

2. Minimum Base-Metal Thickness: As indicated .

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: Matching steel studs .

G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches , matching studs in depth, and not less than 0.033 inch thick.

I. Finish Panels: Gypsum board as specified in Section 09 2900 "Gypsum Board." .

J. Sound Attenuation Blankets: As specified in Section 09 2900 "Gypsum Board."

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 09 2900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).

F. Acoustical Sealant: Section 07 9219 "Acoustical Joint Sealants."

G. Gypsum Board Cants:

1. Gypsum Board Panels: As specified in Section 09 2900 "Gypsum Board," Type X, 1/2- or 5/8-inch panels.
2. Adhesive: Laminating adhesive as specified in Section 09 2900 "Gypsum Board."
3. Non-Load-Bearing Steel Framing: As specified in Section 09 2216 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 8100 "Applied Fireproofing."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.

2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

F. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

G. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

H. Gypsum Board Cants: At projections into shaft exceeding 4 inches , install gypsum board cants covering tops of projections.

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.

2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.

I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 05 4000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.4 QUALITY ASSURANCE

A. Provide the following upon request:

1. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. .

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

2. Protective Coating: ASTM A 653/A 653M, G40 , hot-dip galvanized unless otherwise indicated.

C. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) CEMCO; California Expanded Metal Products Co.

2) MRI Steel Framing, LLC.

3) Steel Network, Inc. (The).

b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection .

c. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to runners while allowing 1-1/2-inch minimum vertical movement.

2. Deflection Track: Slotted steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness as required to meet performane requirements.

E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: As indicated on Drawings.

G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches , 0.068-inch- thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: As indicated on Drawings.
2. Depth: As indicated on Drawings.

I. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: hat shaped.

J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch .
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch- diameter wire.

K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches , wall attachment flange of 7/8 inch , minimum uncoated-metal thickness of 0.0179 inch , and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.

E. Carrying Channels: 1-1/2 inch hot-rolled channels weighing 1.12 pounds per foot.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.

2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: As indicated on Drawings .

b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base-Metal Thickness: As indicated on Drawings .

4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock. Provide grid suspension systems with current ICC Evaluation Service Report (ESR) conforming to ICC AC368, Acceptance Criteria for Suspended Ceiling Framing Systems.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong World Industries, Inc; Drywall Grid Systems.

b. Chicago Metallic Corporation; 640/660 Drywall Ceiling Suspension.

c. United State Gypsum Company; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.

2. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.

2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.

3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

   a. Install jamb studs sized to meet performance requirements.

   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

D. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07 2100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Install in accordance with DSA IR 25-3.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

C. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

D. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

E. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

F. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

G. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

H. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 2400 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior vertical plasterwork (stucco).
2. Exterior horizontal and nonvertical plasterwork (stucco).

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

D. Samples for Verification: For each type of factory-prepared finish coat and for each color and texture specified, 12 by 12 inches, and prepared on rigid backing.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for each substrate and finish texture indicated for cement plastering, including accessories.
   a. Size: 100 sq. ft. in surface area.
2. For interior plasterwork, simulate finished lighting conditions for review of mockups.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

5. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.7 FIELD CONDITIONS

A. Comply with ASTM C 926 requirements.

B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.

2. Apply plaster when ambient temperature is greater than 40 deg F.

3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

~~C. 40 deg F~~

D. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E 119 by a qualified testing agency.

2.2 ASSEMBLY DESCRIPTION :

A. One-Coat Stucco Assembly with Rigid Continuous Insulation with Crack Resistance: Exterior rigid continuous insulation, wire fabric or metal lath, pre-mixed stucco base coat, fiberglass reinforcing mesh embedded in stucco leveling coat, and either an acrylic or elastomeric based finish coat.

B. Stucco Functional Criteria:

1. General: Stucco application shall be to vertical substrates or to substrates sloped for

positive drainage. Substrates sloped for drainage shall have additional protection from weather exposure that might be harmful to coating performance.

2. Testing to meet International Code Council Acceptance Criteria AC11.

3. Performance Requirements of Stucco Assembly.

Accelerated Weathering	ASTM G153	2000 Hours	No deleterious effect
Freeze-Thaw Resistance	ICC AC 11	10 cycles	Pass
Transverse Wind Load Resistance	ASTM E330	Meet Design Loads	Refer to ICC-ES ESR-2564
Fire Resistance	ASTM E119	One hour fire	Refer to ICC-ES ESR-2564
Drainage	ICC AC 11	90 %	Refer to ICC-ES ESR-2564

4. Performance Requirements of Coatings applied to Expanded Polystyrene features: Must comply with ASTM E 2568 or ICC Acceptance Criteria AC 219 for EIFS.

5. Substrate materials and construction shall conform to the building code having jurisdiction.

6. Substrates shall be sound, dry and free of dust, dirt, laitance, efflorescence and other harmful contaminants.

7. Substrate Dimensional Tolerances: Flat with 1/4 in (6.4 mm) within any 10 ft (3 m) radius.

8. Maximum deflection of substrate system under positive or negative design loads shall not exceed L/360 of span.

2.3 METAL LATH

A. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet with ASTM A 653/A 653M, G60, hot-dip galvanized-zinc coating.

1. Manufacturers: Subject to compliance with requirements, ~~[provide products by the following] [provide products by one of the following]~~ [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following~~]~~:

   a. Alabama Metal Industries Corporation; a Gibralter Industries company.
   b. CEMCO; California Expanded Metal Products Co.
   c. ClarkDietrich Building Systems.
   d. MarinoWARE.

2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

3. Diamond-Mesh Lath: Flat, 3.4 lb/sq. yd..

4. Flat-Rib Lath: Rib depth of not more than 1/8 inch, 3.4 lb/sq. yd..

5. 3/8-Inch Rib Lath: 3.4 lb/sq. yd..

1. ~~Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:~~

   ?. ~~Davis Wire Corporation; a Heico Wire Group company~~

?. ~~1.4 lb/sq. yd.1.95 lb/sq. yd.~~

C. Paper Backing: FS UU-B-790a, Type I, Grade D, Style 2 vapor-permeable paper.

1. Provide paper-backed lath in locations indicated on Drawings.

2.4 ACCESSORIES

A. General: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Manufacturers: Subject to compliance with requirements, ~~[provide products by the following] [provide products by one of the following] [~~available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following~~]~~:

   a. Alabama Metal Industries Corporation; a Gibraltar Industries company.
   b. CEMCO; California Expanded Metal Products Co.
   c. ClarkDietrich Building Systems.
   d. MarinoWARE.

2. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A 653/A 653M, G60 zinc coating.

3. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized-zinc coating.

4. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized-zinc coating.

5. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.

   a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
   b. Smallnose cornerbead with perforated flanges; use on curved corners.
   c. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.

6. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.

7. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.

8. Expansion Joints: Fabricated from zinc-coated (galvanized) steel; folded pair of

unperforated screeds in M-shaped configuration; with expanded flanges.

9. Two-Piece Expansion Joints: Fabricated from zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch wide; with perforated flanges.

10. Vented Metal Reveal Trim: Extruded aluminum ventilation screed for 3/4-inch ground, prime painted finish.

    a. Basis-of-Design Product: Fry Reglet Corp.; FPM-75-V-75 or approved comparable product.

~~1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:~~

~~2. Alabama Metal Industries Corporation; a Gibraltar Industries company~~

2.5 MISCELLANEOUS MATERIALS

A. Drainage behind continuous Insulation:

1. Water resistive barrier incorporating in itself a means of drainage and maintaining a current ICC Evaluation Report covered by Flat Insulation board.

2. Water Resistive Barrier covered by Drainage Mat.

B. Continuous Insulation:

1. Expanded (EPS), or Extruded (XPS), having a nominal density of 1 lb/ft³ (14 kg/m³).

C. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.

D. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

2.6 MATERIALS

A. Stucco Base Coat: (3/8 in Ó 1/2 in per coat):

1. Parex 210 Armourwall Stucco Base Concentrate: Proprietary mixture of portland cement and proprietary ingredients mixed with clean, cool, potable water, and ASTM C897 or ASTM C144 sand added in the field.

B. Stucco Admix: Parex USA Adacryl Admix & Bonding Agent: 100% acrylic emulsion additive for portland cement based products to enhance curing, adhesion, freeze-thaw resistance and workability and as an acrylic polymer bonding agent.

C. Leveling and Reinforcing Coat:

1. Parex USA Stucco Level Coat: Copolymer based, factory blend of cement and proprietary ingredients requiring addition of water.

2. Parex 121 Base Coat & Adhesive: 100% acrylic polymer base, requiring the addition of portland cement.

3. Parex USA Reinforcing Meshes:

a. Parex USA 355 Standard Mesh: Weight 4.5 oz/yd ^{2} (153 g/m^2) reinforcing mesh.

D. Expanded Polystyrene Features over Stucco:

1. Adhesive and Base Coat:

a. Parex 121 Dry Base Coat and Adhesive: Copolymer based, factory blend of cement and proprietary ingredients requiring addition of water.

b. Parex 121 Base Coat & Adhesive: 100% acrylic polymer base, requiring the addition of portland cement.

E. EPS-1: Grooved Insulation Board

1. ASTM C578, ASTM E 2430 Type I, and the Parex USA specification for Molded Expanded Polystyrene Insulation board.

F. Primer:

1. Parex USA PrimeShield: 100% acrylic based primer to prepare surfaces for acrylic or elastomeric finishes.

G. Finish:

1. Parex AquaSol: 100% acrylic polymer based finish, enhanced DPR acrylic finish with hydrophobic and photocatalytic properties, repels water, reflects UV rays, and reduces smog particles near the finish surface. Finish type, texture and color as selected by Project Designer.

H. Water: Clean, cool, potable water.

~~3. Products~~

~~?. California Stucco Products Corp~~

~~1. Products~~

~~?. California Stucco Products CorpDryvit Systems, Inc.~~

2.7 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

~~1. 1 lb of fiber/cu. yd.~~

F. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare smooth, solid substrates for plaster according to ASTM C 926.

3.3 INSTALLATION, GENERAL

A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

3.4 INSTALLING METAL LATH

A. Metal Lath: Install according to ASTM C 1063.

1. Partition Framing and Vertical Furring: Install flat-rib lath.
2. Flat-Ceiling and Horizontal Framing: Install 3/8-inch rib lath.
3. Curved-Ceiling Framing: Install flat-diamond-mesh lath.
4. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.5 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install cornerbead at exterior locations.

C. Control Joints: Locate as approved by Architect for visual effect and as follows:

~~?. 144 sq. ft.~~

~~?. 18 feet~~

3.6 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished

plaster surfaces when measured by a 10-foot straightedge placed on surface.

2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 3/4-inch total thickness, as follows:

1. Portland cement mixes.

~~C. 1/2-inch3/4-inch~~

~~D. 3/8-inch1/4-inch~~

~~E. 1/4-inch~~

F. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

3.7 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.8 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

3.9 CEMENT PLASTER FINISH SCHEDULE

A. ACIP-1 Cast in place architectural finish concrete walls

1. Texture: Smooth
   a. ACIP-1A: Vertical Surfaces and Soffits: 2 coat direct applied stucco system
   b. Bonder
   c. 3/8 Brown coat
   d. Base coat/ Reinforcing (121 dry with 355 Parex mesh)

2. Acrylic Plaster Finish coating (AquaSol)

B. ACIP-1B:

1. Plaster Waterproofing

2. 3/8• brown coat

3. Base coat/ Reinforcing (121 dry with 355 Parex mesh)
4. Plaster Water Resistive Barrier
5. Acrylic Plaster Finish coating (AquaSol)

C. ACIP-2 Cast in place architectural finish concrete walls

1. ACIP-2A: Horizontal Surface (Ledges):
   a. Horizontal Surfaces: Soprema Reinforced PMMA Waterproofing System
2. ~~ACIP-2B: Vertical Surfaces and Soffits: Clear Coat~~
   a. ~~Waterproofing: Prosoco SLX100 Water & Oil Repellent~~

D. CP-1 - Integral Color Exterior Cement Plaster with insulation

1. Interior finish: Steel Stud framing and GWB interior finish (as required) installed in a manner that does not interrupt the insulation and thermal barrier.
2. 5/8• Exterior Gypsum Sheathing
3. Air and Moisture Barrier: Parex Water-resistive & Air Barrier Coating or Defendair 200 by Dow Corning
4. Insulation: R14 - 3" of expanded polystyrene ultra-continuous applied to the exterior side of the sheathing.
5. Drainage mat
6. Coating: 3 Coat Plaster system
   a. Paper Backed Metal Lath
   b. Scratch Coat & Brown Coat
   c. Base coat/ Reinforcing (121 dry with 355 Parex mesh)
   d. Acrylic Plaster Finish coating (AquaSol)
7. Finish: Parex and Smooth

E. CP-2 - Integral Color Exterior Cement Plaster without insulation

1. 5/8• Exterior Gypsum Sheathing
2. Air and Moisture Barrier: Parex Water-resistive & Air Barrier Coating or Defendair 200 by Dow Corning
3. Coating: 3 Coat Plaster system
   a. Paper Backed Metal Lath
   b. Scratch Coat & Brown Coat
   c. Base coat/ Reinforcing (121 dry with 355 Parex mesh)
   d. Acrylic Plaster Finish coating (AquaSol)
4. Finish: Parex ÓSand Smooth•

F. CP-3 - Integral Color Exterior Cement Plaster at Soffit

1. Coating: 3 Coat Plaster system
    a. Ribbed Paper Backed Metal Lath
    b. Scratch Coat & Brown Coat
    c. Base coat/ Reinforcing (121 dry with 355 Parex mesh)
    d. Acrylic Plaster Finish coating (AquaSol)
2. Finish: Parex ÓSand Smooth

END OF SECTION

SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 06 1600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 09 2116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
3. Section 09 2216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
4. Section 09 2613 "Gypsum Veneer Plastering" for gypsum base for veneer plaster and for other components of gypsum-veneer-plaster finishes.
5. Section 09 3013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For materials manufactured within 100 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
3. Product Data: For adhesives and sealants, indicating VOC content.
4. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-emitting materials.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

D. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Ceiling and wall materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled

content not less than 25percent.

B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation.
   b. Georgia-Pacific Building Products.
   c. National Gypsum Company.
   d. PABCO Gypsum.
   e. Temple-Inland Building Products by Georgia-Pacific.
   f. United States Gypsum Company.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation.
   b. Georgia-Pacific Building Products.
   c. National Gypsum Company.
   d. Temple-Inland Building Products by Georgia-Pacific.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation.
   b. Custom Building Products.
   c. James Hardie Building Products, Inc.
   d. National Gypsum Company.
   e. United States Gypsum Company.
2. Thickness: 5/8 inch.

3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet .
2. Shapes:
   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. L-Bead: L-shaped; exposed long flange receives joint compound.
   d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   e. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fry Reglet Corporation.
   b. Gordon, Inc.
   c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

D. Firestop Putty Pads for Electrical Boxes: Listed intumescent moldable firestop putty pads. Product: Subject to compliance with requirements, provide one of the following:

1. Hilti Corporation; CP 617 6" x 7" Putty Pad or CP 617L 7" x 7" Putty Pad.
2. Kinetics Noise Control; IsoBacker.
3. Specified Technologies Inc. (STI); SpecSeal Series SSP Putty Pad.

E. Acoustic Putty Pads for Electrical Boxes: Asbestos-free, putty pads composed of polybutene-butyl and inert fillers. Subject to compliance with requirements, provide one of the following:

1. Kinetics Noise Control; IsoBacker.
2. Specified Technologies Inc. (STI); SpecSeal Series SSP Putty Pad.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: As indicated on Drawings .

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation

instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints [at locations indicated on Drawings] [according to ASTM C 840 and in specific locations approved by Architect for visual effect].

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners[unless otherwise indicated].
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.

D. Aluminum Trim: Install in locations indicated on Drawings.

E. Firestop Putty Pads: Install at electrical boxes located in fire-rated partitions. Install in accordance with pad manufacturer's instructions.

F. Acoustic Putty Pads: Install at electrical boxes located in acoustic-rated partitions. Install in accordance with pad manufacturer's instructions.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Where indicated on Drawings.
3. Level 3: Where indicated on Drawings.

4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated including panels scheduled to receive flat or eggshell paint finish, light texture finishes or light-grade wall coverings.
    a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."
5. Level 5: Where indicated on Drawings.
    a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 3013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Glazed wall tile.
3. Stone thresholds.
4. Tile backing panels.
5. Waterproof membrane for thinset applications.
6. Crack isolation membrane.
7. Metal edge strips.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 09 2900 "Gypsum Board" for cementitious backer units glass-mat, water-resistant backer board.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

E. Wet Area: The term "wet area" refers to shower rooms and other areas with similar usages. It does not refer to toilet rooms and other similar areas where water on the floor is seldom encountered.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

E. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.

2. Full-size units of each type of trim and accessory for each color and finish required.

3. Stone thresholds in 6-inch lengths.

4. Metal edge strips in 6-inch lengths.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.

3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

B. Provide the following upon request:

1. Qualification Data: For Installer.
2. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
3. Product Certificates: For each type of product.
4. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

C. Installation method: If the mockup does not pass the 'credit card test', a leveling system shall be used for all tile greater than 12 inches in either dimension to control lippage and other related installation control activities.

1.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.

2. Waterproof membrane.

3. Crack isolation membrane.

4. Cementitious backer units.

5. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Dynamic Coefficient of Friction: Provide tile installed on walkway surfaces with dynamic coefficient of friction indicated as determined by testing identical products per ANSI A13.7.1 DCOF AcuTest procedure.

1. Dynamic Coefficient of Friction: Not less than 0.42.

D. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

F. See Interior Finishes and Materials Legend on drawings.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 12 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 TILE BACKING PANELS

A. Specified in Section 09 2900 "Gypsum Board."

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.

1. Products: Subject to compliance with requirements, provide the following or equal:
   a. Noble Company (The); Nobleseal TS.
2. Nominal Thickness: 0.030 inch.

2.6 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.

1. Products: Subject to compliance with requirements, provide the following or equal:
   a. Noble Company (The); Nobleseal CIS.

2.7 SETTING MATERIALS

A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Custom Building Products.

b. Laticrete International, Inc.

c. MAPEI Corporation.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

2.8 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Custom Building Products.

b. Laticrete International, Inc.

c. MAPEI Corporation.

2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bostik, Inc.

b. C-Cure.

c. Custom Building Products.

d. Laticrete International, Inc.

e. MAPEI Corporation.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Schluter Systems L.P.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.10 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped a maximum of 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    a. Tile floors in wet areas.
    b. Tile floors in laundries.
    c. Tile floors consisting of tiles 8 by 8 inches or larger.
    d. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Glazed Wall Tile: 1/8 inch or less but consistent.
2. Porcelain Tile: 3/16 inch or less but consistent.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. Do not extend waterproofing or under thresholds set in improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproofing or crack isolation membrane with elastomeric sealant.

K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot traffic for at least three days and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation : TCNA F122; thinset mortar on waterproof membrane.
   a. Thinset Mortar: Improved modified dry-setmortar.
   b. Grout: High-performance sanded grout.
2. Ceramic Tile Installation : TCNA F125-Full; thinset mortar on crack isolation membrane.
   a. Thinset Mortar: Improved modified dry-setmortar.
   b. Grout: High-performance unsanded grout.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation : TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
   a. Thinset Mortar: Improved modified dry-set mortar.
   b. Grout: High-performance sanded grout.
2. Ceramic Tile Installation : TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
   a. Thinset Mortar: Improved modified dry-set mortar.
   b. Grout: High-performance sanded grout.

C. Shower Receptor and Wall Installations:

1. Ceramic Tile Installation : TCNA B415; thinset mortar on waterproof membrane over cementitious backer units or fiber-cement backer board.

END OF SECTION

SECTION 09 5113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Laboratory Test Reports: For ceiling products, indicating compliance with requirements for low-emitting materials.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.
3. Clips: Full-size hold-down seismic clips.

E. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/4 inch = 1 foot .

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Provide the following upon request:

1. Qualification Data: For testing agency.

2. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

3. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

4. Field quality-control reports.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Ceiling products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design seismic restraints for ceiling systems.

C. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

D. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.

2. Smoke-Developed Index: 50 or less.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong World Industries, Inc.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Acoustical Panel Ceiling:

1. Basis-of-Design Product:
   a. Acoustical Panel Ceiling: Armstrong World Industries, Inc., Optima #3159.
   b. Metal Suspension System: Armstrong World Industries, Inc.; Clean Room Aluminum, #EA7903.
2. Classification: Provide fire-resistance-rated panels as follows:
   a. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.
   b. Pattern: E (lightly textured) .

2.4 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Extra-Wide-Face, Double -Web, Metal Suspension System: Main and cross runners formed from extruded aluminum to produce structural members with 1-1/2-inch wide flanges.

1. Structural Classification: Heavy-duty system.
2. Face Design: Flat, flush.
3. Face Finish: Painted white.
4. Gasket System: Clean-room type.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    a. Type: Cast-in-place Postinstalled expansion Postinstalled bonded anchors.
    b. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316.
2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
3. Size:
    a. Hanger Wire Size: 0.106 inch (No. 12-gauge) diameter wire.
    b. Seismic Bracing Wire Size: 0.106 inch (No. 12-gauge) diameter wire.

C. Hold-Down Clips: Manufacturer's standard hold-down.

D. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

G. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries, Inc.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard extruded aluminum moldings for edges and penetrations that comply with seismic design requirements; formed from aluminum sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.

2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

3. For circular penetrations of ceiling, provide edge moldings fabricated with 2-inch oversize ring.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils . Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2. Seismic Requirements: Provide manufacturer's seismic perimeter clips used with standard nominal 7/8-inch wall angles, with current ICC Evaluation Service Report (ESR) acceptable to authority having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.

1. Seismic Design Requirements: Install in accordance with the following:
   a. ASTM E 580/E580M **and 2013 CBC.**

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:
   a. As indicated on reflected ceiling plans.
2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
3. Install seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
4. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
5. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.

2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 5133 - ACOUSTICAL METAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section

1.2 SUMMARY

A. Section Includes

1. Acoustical metal ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Related Sections:

1. Section 09 5113 - Acoustical Ceiling Suspension Assemblies
2. Divisions 23 - HVAC Air Distribution
3. Division 26 - Electrical

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.

C. Acoustic Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device.

D. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.6 PROJECT CONDITIONS

A. Space Enclosure: Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

1.7 LEED

A. Category - Material & Resources

1. MR Credit 2.1, 2.2 - Construction Waste Management Divert 50% or 75% from disposal
2. MR Credit 4.1, 4.2 - Recycled Content
3. MR Credit 5.1, 5.2 - Regional Materials (dependent on location)

B. LEED NC - 10% Extracted, Processed & Manufactured Regionally LEED CI - 20% Manufactured Regionally

1. Category - Indoor Environmental Quality
   a. EQ Credit 4.1 to 4.6 - Low-Emitting Materials
   b. Category - Innovation and Design Process
   c. ID Credit - Acoustic Performance

1.8 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical Metal panels: One (1) year from date of substantial completion
2. Grid: One (1) year from date of substantial completion

C. Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Metal Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. See Interiors Finish Materials Legend on drawings.

2.2 ACOUSTICAL CEILING UNITS

A. Acoustical Panels Type

1. See Interior Finish Materials Legend on drawings.

2.3 METAL SUSPENSION SYSTEMS

A. Components:

1. Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
   a. Structural Classification: ASTM C 635 Heavy Duty duty
   b. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
   c. Recycle Content: Post-Consumer - 50% Pre-Consumer - 11%
   d. Acceptable Product:
      1) PRELUDE XL 15/16" Exposed Tee as manufactured by Armstrong World Industries

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Accessories:
   1. 5594 - Compression Strut
   2. 7445 - Stabilizer Bar

2.4 ALUMINUM CUSTOM TRIM - EXTRUDED

A. Product/Manufacturer: Axiom Trim Channel: 2in Axiom Interlude Straight Armstrong World Industries, Incorporated

B. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanizedsteel unfinished T-bar connection clips; galvanized steel splice plates.
   1. Color: White
   2. Size: 120IN X 2IN
   3. Recycle Content: Post-Consumer - 50% Pre-Consumer - 0%
   4. Acceptable Product:
      a. AXIOM for INTERLUDE, 2in Axiom Interlude Straight as manufactured by Armstrong World Industries

C. Trim Channel:
   1. 2in Axiom Interlude Straight

D. Axiom Accessories:

PART 3 - AX4SPLICE - Splice Plate with SetscrewsEXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Follow manufacturer installation instructions

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

D. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

E. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION|

SECTION 09 6340 - STONE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Dimension stone stair treads.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for sealing joints in stone flooring system with elastomeric sealants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

1. Show locations and details of joints both within stone flooring and between stone flooring and other finish materials.

2. Show direction of veining, grain, or other directional patterns.

C. Samples for Verification:

1. For each stone type indicated, in sets of Samples not less than 12 inches square. Include at least three or more Samples in each set and show the full range of color and other visual characteristics in completed Work.

2. For each color of grout required.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For stone flooring to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone flooring.

B. Installer Qualifications: Fabricator of stone flooring.

C. Installer Qualifications: A firm or individual experienced in installing stone flooring similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.

D. Provide the following upon request:

1. Qualification Data: For fabricator.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.

2. Store stone on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. Mark stone units, on surface that is concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels, so that they are right side up when units are installed.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.8 FIELD CONDITIONS

A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg Fduring installation and for seven days after completion.

B. Cold-Weather Requirements for Exterior Stone Flooring: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

C. Hot-Weather Requirements for Stone Flooring: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. Maintain temperature of materials below 100 deg F.

2. Do not apply mortar to substrates with temperatures of 100 deg F and above.

3. When the ambient temperature exceeds 90 deg F, fog spray installed stone flooring until

damp at least three times a day until flooring is three days old.

PART 2 - PRODUCTS

2.1 OTHER STONE <Insert drawing designation>

1. Padang Dark (Black Basalt).

B. Finish: Flamed top surface and honed exposed edges.

C. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.2 MORTAR MATERIALS

A. Thinset Mortar:

1. Improved Modified Dry-Set Mortar: ANSI A118.15.
   a. Mixture of Dry-Mortar Mix and Latex Additive: Mixture of packaged dry-mortar mix and styrene-butadiene-rubber or acrylic-resin liquid-latex additive.

B. Water: Potable.

2.3 GROUT

A. Grout Colors: As selected by Architect from manufacturer's full range.

B. High-Performance Cement Grout: ANSI A118.7, packaged.

1. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to packaged dry-grout mix.
2. Sanded grout mix for joints wider than 1/8 inch .

2.4 ACCESSORIES

A. Temporary Spacers: Resilient plastic, nonstaining to stone, sized to suit joint thickness.

B. Abrasive Inserts for Stair Treads: Abrasive strips consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder, fabricated for installing in routed grooves of stair treads to provide slip resistance. Provide epoxy-resin installation adhesive compatible with inserts.

1. Width: 1/4 inch .
2. Depth: 1/2 inch .
3. Length: As indicated.

C. Joint Sealants: Manufacturer's standard sealants that comply with applicable requirements in Section 07 9200 "Joint Sealants" and will not stain the stone they are applied to.

1. Colors: Provide colors of exposed sealants to match other joints in stone adjoining sealed

joints unless otherwise indicated.

D. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer[and by sealer manufacturer]. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

E. Floor Sealer: Colorless, slip- and stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

2.5 MORTAR AND GROUT MIXES

A. Mortar: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

B. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions and to produce a stiff mixture with a moist surface when bed is ready to receive stone.

C. Latex-Modified Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.

D. Joint Grout: Comply with mixing requirements in referenced ANSI standards and with manufacturer's written instructions.

2.6 STONE FABRICATION

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

B. Fabricate stone to comply with requirements indicated and with the following references:

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."

C. Cut stone to produce pieces of thickness, size, and shape indicated.

1. Stone Edges: As indicated.

D. Fabricate stone stair treads in sizes and profiles indicated. Rout grooves into treads to receive abrasive strips and install strips to comply with manufacturer's written instructions.

E. Carefully inspect finished stone units at fabrication plant for compliance with appearance, material, and fabrication requirements. Replace defective units. Clean sawed backs of stones to remove rust stains and iron particles.

1. Grade and select stone for overall uniform appearance when assembled in place.

2. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive stone flooring and conditions under which stone flooring will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone flooring.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone flooring.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Vacuum concrete substrates to remove dirt, dust, debris, and loose particles.

B. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

C. Before setting stone, clean dirty or stained stone surfaces by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 INSTALLATION, GENERAL

A. Do necessary field cutting as stone is set. Cut lines straight and true, and finish field-cut edges to match shop-cut edges.

1. Use power saws with diamond blades to cut stone.

B. Set stone to comply with requirements indicated.

C. Scribe and field cut stone as necessary to fit at obstructions. Produce neat joints of size specified or indicated.

D. Provide control and expansion joints of widths and at locations indicated. Keep control and expansion joints free of mortar, grout, and other rigid materials.

3.4 INSTALLATION TOLERANCES

A. Variation in Line: For positions shown in plan for edges of flooring, ramps, steps, changes in color or finish, and continuous joint lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.

B. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 inch or one-fourth of nominal joint width, whichever is less.

C. Variation in Surface Plane: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum from level or slope indicated.

D. Variation in Plane between Adjacent Units (Lipping): Do not exceed 1/32-inch difference between planes of adjacent units.

3.5 INSTALLATION OF STONE BONDED TO CONCRETE

A. Saturate concrete with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat to damp concrete and broom to provide an even coating that completely covers the concrete. Do not exceed 1/16-inch thickness. Limit area of mortar-bed bond coat to avoid its drying out before placing setting bed.

C. Apply mortar bed immediately after applying mortar-bed bond coat. Spread, tamp, and screed to uniform thickness at elevations required for setting stone to finished elevations indicated.

D. Mix and place only that amount of mortar bed that can be covered with stone before initial set. Cut back, bevel edge, and discard material that has reached initial set before stone can be placed.

E. Place stone before initial set of mortar occurs. Immediately before placing stone on setting bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each stone unit.

F. Tamp and beat stone with a wooden block or rubber mallet to obtain full contact with mortar bed and to bring finished surfaces within indicated tolerances. Set each unit in a single operation before initial set of mortar; do not return to areas already set and disturb stone for purposes of realigning finished surfaces or adjusting joints.

G. Rake out joints to depth required to receive grout as units are set.

3.6 STONE STAIR TREAD INSTALLATION

A. Install stone stair treads to comply with "Installation of Stone Bonded to Concrete" Article.

B. Install stone stair treads in thinset mortar to comply with ANSI A108.5.

3.7 GROUTING

A. Grout stone joints to comply with ANSI A108.10 and with manufacturer's written instructions.

1. Grout joints as soon as possible after initial set of setting bed. Force grout into joints, taking care not to smear grout on adjoining stone and other surfaces. After initial set of grout, finish joints by tooling to produce a slightly concave polished joint, free of drying cracks.

3.8 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable

requirements in Section 07 9200 "Joint Sealants."

3.9 ADJUSTING AND CLEANING

A. Remove and replace stonework of the following description:

1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
2. Defective joints.
3. Stone flooring and joints not matching approved Samples and mockups.
4. Stonework not complying with other requirements indicated.

B. Replace in a manner that results in stonework matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stonework as work progresses. Remove grout smears before tooling joints.

D. Clean stonework after setting and grouting are complete. Use procedures recommended by stone fabricator for application types.

E. Apply sealer to cleaned stonework according to sealer manufacturer's written instructions.

3.10 PROTECTION

A. Prohibit traffic from installed stone for a minimum of 72 hours.

B. Protect installed stonework during construction with nonstaining kraft paper. Where adjoining areas require construction work access, cover stonework with a minimum of 3/4-inch untreated plywood over nonstaining kraft paper.

END OF SECTION

SECTION 09 6513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

B. Related Requirements:

1. Section 09 0561.13 "Moisture Vapor Emission Control."

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For resilient base, indicating compliance with requirements for low-emitting materials.

D. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

E. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Resilient base shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 THERMOSET-RUBBER BASE

A. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:
   a. Style A, Straight: Provide in areas with carpet.
   b. Style B, Cove: Provide in areas with resilient flooring.

B. Thickness: 0.125 inch.

C. Height: As indicated on Drawings.

D. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

E. Outside Corners: Job formed.

F. Inside Corners: Job formed.

G. Colors: As selected by Architect from full range of industry colors.

2.3 RUBBER MOLDING ACCESSORY

A. Description: Rubber cap for cove carpet cap for cove resilient flooring carpet edge for glue-down applicationsnosing for carpet nosing for resilient flooring reducer strip for resilient flooring joiner for tile and carpet.

B. Profile and Dimensions: As indicated.

C. Locations: Provide rubber molding accessories in areas indicated.

D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
   a. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
   a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 09 6516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes vinyl and rubber sheet flooring.

B. Related Requirements:

1. Section 09 0561.13 "Moisture Vapor Emission Control."

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For adhesives indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For chemical-bonding compounds, indicating VOC content.
4. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For each type of flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

E. Samples: For each exposed product and for each color and texture specified in manufacturer's standard size, but not less than 6-by-9-inch sections.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

F. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern of resilient sheet flooring required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

G. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

H. Product Schedule: For resilient sheet flooring. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Certifications: Submit a certification signed by the manufacturer and installer stating that the resilient flooring has been installed as specified and in accordance with fire-test response characteristics.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Sheet Flooring: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

B. Provide the following upon request;

1. Qualification Data: For Installer.

1.8 ~~100 sq. ft.~~ DELIVERY, STORAGE, AND HANDLING

A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during resilient sheet flooring installation.

D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.

E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Slip Resistance: 0.42 DCOF wet. Comply with CBC 11B.302.1 and ~~ANSI A137.1~~ ANSI A326.3 for dynamic coefficient of friction (DCOF).

2.2 ~~ProductsArmstrong World Industries, Inc~~VINYL SHEET FLOORING WITH BACKING

A. See Interior Finishes and Materials Legend on drawings.

B. ~~ProductsAltro Group~~Product Standard: ASTM F 1303.

1. Type (Binder Content): Type I, minimum binder content of 90 percent.
2. Wear-Layer Thickness: Grade 1.
3. Overall Thickness: As standard with manufacturer.
4. Backing Class: Class A (fibrous).

C. Wearing Surface: Smooth.

D. Sheet Width: As standard with manufacturer.

E. Seamless-Installation Method: Heat welded.

F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 UNBACKED RUBBER SHEET FLOORING

A. See Interior Finishes and Materials Legend on drawings.

B. Product Standard: ASTM F 1859.

1. Type: Type I (homogeneous rubber sheet).

2. Thickness: As standard with manufacturer.

3. Hardness: Not less than required by ASTM F 1859.

C. Wearing Surface: Smooth.

D. Sheet Width: As standard with manufacturer.

E. Seamless-Installation Method: Heat welded.

F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

a. Color: As selected by Architect from manufacturer's full range to contrast with flooring.

D. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.

2. Cap Strip: Square metal, vinyl, or rubber cap provided or approved by resilient sheet flooring manufacturer.

3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:

a. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

b. If water moisture tests exceed stated limits, apply vapor retarder for moisture vapor emission control as specified.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.

B. Perform the following operations immediately after completing resilient sheet flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION

SECTION 09 6519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.
2. Luxury Vinyl Tile.

B. Related Requirements:

1. Section 09 0561.13 "Moisture Vapor Emission Control."
2. Section 09 6513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
3. Section 09 6516 "Resilient Sheet Flooring" for resilient sheet floor coverings.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and . Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For chemical-bonding compounds, indicating VOC content.
4. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
5. Product Data: For sealants, indicating VOC content.
6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
7. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

E. ~~9 inches~~Samples for Verification: Full-size units of each color and pattern of floor tile required.

F. ~~9 inches6-by-9-inch~~Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Certifications: Submit a certification signed by the manufacturer and installer stating that the resilient flooring has been installed as specified and in accordance with fire-test response characteristics.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. Provide the following upon request:

1. Qualification Data: For Installer.

1.8 ~~100 sq. ft.~~ DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than

70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Flooring products shall comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Slip Resistance: 0.42 DCOF wet. Comply with CBC 11B.302.1 and ANSI A326.3 for dynamic coefficient of friction (DCOF).

2.2 SOLID VINYL FLOOR TILE

A. See Interior Finishes and Materials Legend on drawings.

B. ~~ProductsAB; American Biltrite~~Tile Standard: ASTM F 1700.

1. Class: Class III, printed film vinyl tile.
2. Type: A, smooth surface.

C. Thickness: 0.080 inch~~0.100 inch0.120 inch0.125 inch~~.

D. Colors and Patterns: As indicated by manufacturer's designations .

2.3 ~~ProductsAB; American Biltrite0.125 inch~~VINYL COMPOSITION FLOOR TILE

A. ~~ProductsAB; American Biltrite~~See Interior Finishes and Materials Legend on drawings.

B. Tile Standard: ASTM F 1066, Class 1, solid-color tile.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch.

E. Size: 12 by 12 inches.

F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

   a. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

5. If water moisture tests exceed stated limits, apply vapor retarder for moisture vapor emission control as specified.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.

2. Sweep and vacuum surfaces thoroughly.

3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 6723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes resinous flooring systems.

B. Related Sections:

1. Section 09 0561.13 "Moisture Vapor Emission Control."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and . Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For liquid-applied flooring components, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4.2: For resinous flooring systems, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

C. Provide the following upon request:

1. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

2. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 96-inch- square floor area selected by Architect.

a. Include 96-inch length of integral cove base with inside and outside corner.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERORMANCE REQUIREMENTS

A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Flammability: Self-extinguishing according to ASTM D 635.

D. Slip Resistance: 0.42 DCOF wet. Comply with CBC 11B.302.1 and ANSI A326.3 for dynamic coefficient of friction (DCOF).

2.2 MANUFACTURERS

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.3 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

1. See Interior Finish Materials Legend on drawings.

B. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Textured for slip resistance.
3. Overall System Thickness: 3/16 inch.

C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

E. Body Coats:

1. Resin: Epoxy .

2. Formulation Description: High solids.
3. Type: Pigmented.
4. Application Method: Troweled or screeded.
5. Number of Coats: One.
6. Thickness of Coats: 1/8 inch.
7. Aggregates: Colored quartz (ceramic-coated silica).

F. Topcoats: Sealing or finish coats.

1. Resin: Epoxy .
2. Formulation Description: High solids.
3. Type: Clear.
4. Number of Coats: One.
5. Thickness of Coats: 1/16 inch.
6. Finish: Matte.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:
   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
   a. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
   b. If water moisture tests exceed stated limits, apply vapor retarder for moisture vapor emission control as specified.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 4 inches high.

D. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.

E. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.3 FIELD QUALITY CONTROL

A. Material Sampling: Owner may, at any time and any number of times during resinous flooring application, require material samples for testing for compliance with requirements.

3.4 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing

by resinous flooring manufacturer.

END OF SECTION

SECTION 09 6813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes modular carpet tile.

B. Related Requirements:

1. Section 09 0561.13 "Moisture Vapor Emission Control."
2. Section 09 6513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
   a. Review delivery, storage, and handling procedures.
   b. Review ambient conditions and ventilation procedures.
   c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

C. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

E. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

F. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

G. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Provide the following upon request:

1. Qualification Data: For Installer.

2. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.

2. Failures include, but are not limited to, the following:
   a. More than 10 percent edge raveling, snags, and runs.
   b. Dimensional instability.
   c. Excess static discharge.
   d. Loss of tuft-bind strength.
   e. Loss of face fiber.
   f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. See Interior Finishes and Materials Legend on drawings.

B. Color: As selected by Architect from manufacturer's full range.

C. Pattern: Match Architect's samples.

D. Sustainable Design Requirements:

1. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 03 3000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

b. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

c. If water moisture tests exceed stated limits, apply vapor retarder for moisture vapor emission control as specified.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive .

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns indicated on Drawings.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.

2. Remove yarns that protrude from carpet tile surface.

3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 8433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

1. Sound-absorbing wall panels.

1.3 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. SAA: Sound Absorption Average.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include fabric facing, panel edge, core material, and mounting indicated.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Product Certificates for Credit MR 5, Option 1: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost, location of manufacturer, and distance to Project for each regionally manufactured material.

3. Certificates for Credit MR 7: Chain-of-custody certificates indicating that wood-based products used in units comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.

4. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
5. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Product Data for Credit IEQ 4.4: For composite wood products used in units, documentation indicating that product contains no urea formaldehyde.
7. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products used in units, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
8. Laboratory Test Reports for Credit IEQ 4.6: For units, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings: For unit assembly and installation.

1. Include plans, elevations, sections, and mounting devices and details.
2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
3. Include details at cutouts and penetrations for other work.
4. Include direction of fabric weave and pattern matching.

E. Samples for Verification: For the following products:

1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.
3. Core Material: 12-inch- square Sample at corner.
4. Mounting Devices: Full-size Samples.
5. Assembled Panels: Approximately 36 by 36 inches , including joints and mounting methods.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Electrical outlets, switches, and thermostats.

2. Items penetrating or covered by units including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Alarms.
   e. Sprinklers.
   f. Access panels.
3. Show operation of hinged and sliding components covered by or adjacent to units.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
   2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

1.9 QUALITY ASSURANCE

A. Provide the following upon request:
   1. Product Certificates: For each type of unit.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.

C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:
   a. Acoustical performance.
   b. Fabric sagging, distorting, or releasing from panel edge.
   c. Warping of core.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Units shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.
2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.2 SOUND-ABSORBING WALL UNITS

A. Sound-Absorbing Wall Panel : Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

1. See Interior Finishes and Materials Legend on drawings.
2. Panel Shape: As indicated on Drawings.

3. Mounting: Back mounted with manufacturer's standard metal clips or bar hangers, secured to substrate.
4. Core: Manufacturer's standard .
5. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
6. Edge Profile: Long edges kerfed and rabbeted to receive splines .
7. Corner Detail in Elevation: Square with continuous edge profile indicated.
8. Reveals between Panels: Recessed reveals as selected by Architect from manufacturer's full range.
9. Facing Material: As indicated on Drawings.
10. Acoustical Performance: Sound absorption NRC of not less than 0.65 according to ASTM C 423 for Type A mounting according to ASTM E 795.

2.3 MATERIALS

A. Sustainable Design Requirements:

1. Certified Wood: Wood for units shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

B. Core Materials:

1. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively; minimum density of 13 lb/cu. ft., and with perforated surface.
2. Medium-Density Fiberboard: Panels complying with ANSI A208.2, grade to suit performance requirements.
    a. Made with binder containing no urea formaldehyde.
    b. Use panels that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    c. Fire-retardant panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84 or UL 723.
3. Tackable, Impact-Resistant, High-Density Board for Face Layer: 1/8-inch- thick layer of compressed molded glass-fiber board with a nominal density of 16 to 18 lb/cu. ft. laminated to face of core.

C. Facing Material : Fabric from same dye lot; color and pattern as indicated by manufacturer's designations.

D. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:

1. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

2.4 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Edge Hardening: For glass-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.

C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

D. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

1. Square Corners: Tailor corners.

2. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.

E. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.

2. Edge straightness.

3. Overall length and width.

4. Squareness from corner to corner.

5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches , noncumulative.

B. Variation of Joint Width: Not more than 1/16-inch variation from hairline in 48 inches , noncumulative.

3.4 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

SECTION 09 9113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on exterior substrates.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 05 5000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 05 5213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
4. Section 09 9600 "High-Performance Coatings" for tile-like coatings.

1.3 DEFINITIONS

A. MPI Gloss Level 1 (Matte or Flat Finish): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2 (Velvet Finish): Not more than 0 to 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3 (Velvet Finish): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4 (Satin Finish): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5 (Semi-Gloss Finish): 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6 (Gloss Finish): 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7 (High-Gloss Finish): More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials[, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

1. Provide products from manufacturer's premium or professional product line.

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of the South Coast Air Quality Management District (SCAQMD), Rule 1113, effective 07/01/2008: ~~the Bay Air Quality Management District (BAAQMD), Reg. 8, Rule 3, effective 01/01/2004:~~

1. Flat Paints, Coatings, and Primers: 50 g/L.

2. Nonflat Paints, Coatings, and Primers: 50 g/L.

3. Nonflat (High Gloss) Paints, Coatings, and Primers: 50 g/L.

4. Primers, Sealers, and Undercoaters: 100 g/L.

5. Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: 100 g/L.

6. Clear Wood Finishes, Lacquers: 275 g/L.

7. Clear Wood Finishes, Varnishes: 275 g/L.

8. Floor Coatings: 50 g/L.

9. High Temperature Industrial Maintenance Coatings: 420 g/L.
10. Industrial Maintenance Coatings: 100 g/L.
11. Pretreatment Wash Primers: 420 g/L.
12. Shellacs, Clear: 730 g/L.
13. Shellacs, Pigmented: 550 g/L.
14. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
15. ~~Flat Paints, Coatings, and Primers: 100 g/L.~~
16. ~~Nonflat Paints, Coatings, and Primers: 150 g/L.~~
17. ~~Nonflat (High Gloss) Paints, Coatings, and Primers: 250 g/L.~~
18. ~~Primers, Sealers, and Undercoaters: 200 g/L.~~
19. ~~Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: 400 g/L.~~
20. ~~Clear Wood Finishes, Lacquers: 550 g/L.~~
21. ~~Clear Wood Finishes, Varnishes: 350 g/L.~~
22. ~~Floor Coatings: 250 g/L.~~
23. ~~High Temperature Industrial Maintenance Coatings: 420 g/L.~~
24. ~~Industrial Maintenance Coatings: 250 g/L.~~
25. ~~Pretreatment Wash Primers: 420 g/L.~~
26. ~~Shellacs, Clear: 730 g/L.~~
27. ~~Shellacs, Pigmented: 550 g/L.~~
28. ~~Zinc-Rich Industrial Maintenance Primers: 250 g/L.~~

D. Colors: As indicated in a color schedule.
   1. Ten percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.

4. Paint entire exposed surface of window frames and sashes.

5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:
   a. Equipment, including panelboards[**and switch gear**].
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.1B:
    a. Prime Coat: Primer, zinc rich, inorganic, MPI #19.
    b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
    d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

B. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.3G:
    a. Prime Coat: Primer, galvanized, water based, MPI #134.
    b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
    d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

END OF SECTION

SECTION 09 9123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SUMMARY

1. Section includes surface preparation and the application of paint systems on interior substrates.

C. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for shop priming metal fabrications.
2. Section 05 5113 "Metal Pan Stairs" for shop priming metal pan stairs.
3. Section 05 5119 "Metal Grating Stairs" for shop priming metal grating stairs.
4. Section 05 5213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
5. Section 05 5313 "Bar Gratings" for shop priming metal gratings.
6. Section 09 9600 "High-Performance Coatings" for tile-like coatings.

1.2 DEFINITIONS

A. MPI Gloss Level 1 (Matte or Flat Finish): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2 (Velvet Finish): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3 (Eggshell Finish): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4 (Satin Finish): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5 (Semi-Gloss Finish): 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6 (Gloss Finish): 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7 (High-Gloss Finish): More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

2. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.

2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.

2. Apply coats on Samples in steps to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Benjamin Moore & Co.
2. Dunn-Edwards Corporation.
3. Kelly-Moore Paint Company Inc.
4. Sherwin-Williams Company (The).
5. Vista Paint Company Corporation

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

1. Provide products from manufacturer's premium or professional product line.

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with South Coast Air Quality Management District (SCAQMD), Rule 1113, effective 07/01/2008:~~Bay Area Air Quality Management District (BAAQMD), Reg. 8, Rule 3, effective 01/01/2004~~:

1. Flat Paints, Coatings, and Primers: 50 g/L.
2. Nonflat Paints, Coatings, and Primers: 50 g/L.
3. Nonflat (High Gloss) Paints, Coatings, and Primers: 50 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: 100 g/L.
6. Clear Wood Finishes, Lacquers: 275 g/L.
7. Clear Wood Finishes, Varnishes: 275 g/L.
8. Dry-Fog Coatings: 150 g/L.
9. Floor Coatings: 50 g/L.
10. High Temperature Industrial Maintenance Coatings: 420 g/L.

11. Industrial Maintenance Coatings: 100 g/L.
12. Pretreatment Wash Primers: 420 g/L.
13. Shellacs, Clear: 730 g/L.
14. Shellacs, Pigmented: 550 g/L.
15. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
16. ~~Flat Paints, Coatings, and Primers: 100 g/L.~~
17. ~~Nonflat Paints, Coatings, and Primers: 150 g/L.~~
18. ~~Nonflat (High Gloss) Paints, Coatings, and Primers: 250 g/L.~~
19. ~~Primers, Sealers, and Undercoaters: 200 g/L.~~
20. ~~Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: 400 g/L.~~
21. ~~Clear Wood Finishes, Lacquers: 550 g/L.~~
22. ~~Clear Wood Finishes, Varnishes: 350 g/L.~~
23. ~~Dry-Fog Coatings: 400 g/L.~~
24. ~~Floor Coatings: 250 g/L.~~
25. ~~High Temperature Industrial Maintenance Coatings: 420 g/L.~~
26. ~~Industrial Maintenance Coatings: 250 g/L.~~
27. ~~Pretreatment Wash Primers: 420 g/L.~~
28. ~~Shellacs, Clear: 730 g/L.~~
29. ~~Shellacs, Pigmented: 550 g/L.~~
30. ~~Zinc-Rich Industrial Maintenance Primers: 250 g/L.~~

D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Colors: As indicated in a color schedule.

1. Ten percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.
4. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms or where exposed to elements, moisture, or corrosion:
    a. Equipment, including panelboards and switch gear.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Tanks that do not have factory-applied final finishes.

g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   g. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIRE-RATED AND SMOKE CONTAINMENT ASSEMBLIES

A. Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:
   1. Be located in accessible concealed floor, floor-ceiling or attic spaces; and
   2. Be repeated at intervals not exceeding 30 feet measured horizontally along both sides of the wall or partition; and
   3. Include lettering not less than 0.5 inch in height, incorporating the suggested wording: " X HOUR FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS" or other wording approved or required by AHJ (Authority Having Jurisdiction). Replace “X” with the appropriate designated hourly rating.
   4. Apply a minimum one-inch wide bright red horizontal line, both sides of wall, interrupted for approved text, at the required interval.

B. Refer to the Life Safety Plan and Construction Subsystems Drawings for locations of walls and applicable ratings.

3.5 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System MPI INT 3.1A:
    a. Prime Coat: Latex, interior, matching topcoat.
    b. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
    c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

B. Steel Substrates:

1. Latex System, Alkyd Primer MPI INT 5.1Q:
    a. Prime Coat: Shop primer specified in Section where substrate is specified.
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

C. Galvanized-Metal Substrates:

1. Latex System MPI INT 5.3A:
    a. Prime Coat: Primer, galvanized, water based, MPI #134.
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

D. Wood Substrates: Wood trim Doors.

1. High-Performance Architectural Latex System MPI INT 6.3A:
    a. Prime Coat: Primer, latex, for interior wood, MPI #39.
    b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
    c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

E. Gypsum Board and Plaster Substrates:

1. High-Performance Architectural Latex System MPI INT 9.2B:
   a. Prime Coat: Primer sealer, latex, interior, MPI #50.
   b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
   c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.
   d. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

END OF SECTION

SECTION 09 9313 - CONCRETE FLOOR SEALING

PART 1 - GENERAL

1.1 SUMMARY

A. Applied sealer for horizontal cast-in-place concrete surfaces.

B. Related Sections:

1. Section 03 3000 - Cast-In-Place Concrete.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions.

1.3 QUALITY ASSURANCE

A. Installer: Licensed installers, experienced and trained in the use of these products.

B. Suitability of Substrate: Do not apply to concrete surfaces which may have insufficient chemical reaction, including older or weather concrete, concrete subject to runoff or weathered concrete, or heavily sandblasted concrete.

C. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and applicable codes at the location of the project.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in unopened factory labeled packages. Protect from damage.

B. Store in a safe place, out of direct sunlight. Keep containers tightly sealed. Do not allow product to freeze. Use within manufacturer’s recommended shelf life, approximately 12 months.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Sealer: Sealer by Monochem, Aquaseal W20.

1. VOC: 0.

2. Coverage: As recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to start of application, inspect existing conditions to ensure surfaces are suitable for installation including the following:

1. Concrete has cured for a minimum of 28 days ~~prior to application of stain~~.
2. Surface is completely free of sealers, oils, dirt, paint, alkali, penetrating sealers and foreign materials ~~that would prevent the stain from penetrating the concrete surface~~.
3. Concrete has been swept clean.
4. Test area has been approved.

3.2 APPLICATION

A. Concrete Sealer:

1. Strictly comply with manufacturer's installation recommendations.
2. Apply at rated recommended by manufacturer.
3. Clean surface as recommended by manufacturer.

3.3 CLEANING AND PROTECTION

A. Protection: Do not cover, but protect floor area from paint and other contaminates that could inhibit the stain.

END OF SECTION

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems.

B. Related Requirements:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 05 5213 "Pipe and Tube Railings" for shop priming pipe and tube railings with coatings specified in this Section.
3. Section 09 9113 "Exterior Painting" for general field painting.

1.3 DEFINITIONS

A. MPI Gloss Level 5 (Semi-Gloss Finish): 35 to 70 units at 60 degrees, according to ASTM D 523.

B. MPI Gloss Level 6 (Gloss Finish): 70 to 85 units at 60 degrees, according to ASTM D 523.

C. MPI Gloss Level 7 (High-Gloss Finish): More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include ~~printout of current "MPI Approved Products List"~~ product list for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
   a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Comply with requirements of Section 01 4339 "Exterior Walls Mockups".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures

are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

~~?.~~ ~~Behr Process Corporation~~

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

~~A.~~ ~~MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."~~

~~1.~~ Provide products from manufacturer's premium or professional product line.

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

3. Products shall be of same manufacturer for each coat in a coating system.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of the South Coast Air Quality Management District (SCAQMD), Rule 1113, effective 07/01/2008 and the following VOC content limits:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.

2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.

3. Nonflat (High Gloss) Paints, Coatings, and Primers: VOC content of not more than 50 g/L.

4. Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC content of not more than 100 g/L.

5. Clear Wood Finishes, Varnishes: VOC not more than 275 g/L.

6. Clear Wood Finishes, Lacquers: VOC not more than 275 g/L.

7. Floor Coatings: VOC not more than 50 g/L.

8. Shellacs, Clear: VOC not more than 730 g/L.

9. Shellacs, Pigmented: VOC not more than 550 g/L.

10. Primers, Sealers, and Undercoaters: VOC content of not more than 100 g/L.

D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department

of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Colors: As indicated in color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches .

2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.

2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.

2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy-Modified Latex System ~~MPI EXT 3.1E~~:
   a. Prime Coat: Epoxy-modified latex, matching topcoat.
   b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
   c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5)~~, MPI #215~~.

B. Steel Substrates:

1. Epoxy System ~~MPI EXT 5.1F~~:
   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, ~~MPI #101~~.
   b. Intermediate Coat: Epoxy, high build, low gloss, ~~MPI #108~~.
   c. Topcoat: Epoxy, gloss, ~~MPI #77~~.

C. Galvanized-Metal Substrates:

1. Epoxy System ~~MPI EXT 5.3C~~:
   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, ~~MPI #101~~.
   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, gloss, ~~MPI #77~~.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy-Modified Latex System ~~MPI INT 3.1G~~:
   a. Prime Coat: Epoxy-modified latex, matching topcoat.
   b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
   c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), ~~MPI #215~~.

B. Steel Substrates:

1. Epoxy System MPI INT 5.1L:
    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, ~~MPI #101~~.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, gloss, ~~MPI #77~~.

C. Galvanized-Metal Substrates:

1. Epoxy over Epoxy Primer System MPI INT 5.3D:
    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, ~~MPI #101~~.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, gloss, ~~MPI #77~~.

D. Gypsum Board Substrates:

1. Epoxy-Modified Latex System MPI INT 9.2F:
    a. Prime Coat: Primer sealer, latex, interior, ~~MPI #50~~.
    b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
    c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), ~~MPI #215~~.

END OF SECTION

SECTION 09 9653 - ELASTOMERIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of elastomeric coatings to the following exterior substrates:

1. Concrete unit masonry.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Indicate VOC content.

B. Samples for Verification: For each type of elastomeric coating indicated and in each color and gloss.

1. Submit Samples on same type of substrate as that to receive application, 8 inches square.
2. Apply coats on Samples in steps to show each separate coat, including primers and block fillers as applicable.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent but not less than 1 gal. of each material, color, and texture applied.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 90 deg F unless otherwise permitted by manufacturer's written instructions.

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Water penetration through the coating.
   b. Deterioration of coating beyond normal weathering.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Dow Corning, Basis of Design: AllGuard Silicone Elastomeric Coating.

2.2 MATERIALS

A. Moisture-Vapor Transmission: Minimum 43.2, based on testing according to ASTM D 1653.

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Colors: As selected by Architect from manufacturer's full range.

D. Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated.

E. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.

B. Begin coating only when moisture content of substrate is 12 percent or less when measured with an electronic moisture meter.

C. Begin coating no sooner than 28 days after substrate is constructed and is visually dry on both sides.

D. Verify that substrate is within the range of alkalinity recommended by manufacturer.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.

B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.

2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.

D. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.

3.3 APPLICATION

A. Apply elastomeric coatings according to manufacturer's written instructions.

1. Use equipment and techniques best suited for substrate and type of material being applied.
2. Coat surfaces behind movable items the same as similar exposed surfaces.
3. Apply each coat separately according to manufacturer's written instructions.

B. Primers: Apply at a rate to ensure complete coverage.

C. Elastomeric Finish Coat(s): Manufacturer's recommended number of coats and total dry film thickness for condition of substrate.

D. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats similar to color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

E. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform finish, color, and appearance.

F. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

G. Apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration.

H. Spray Application: Use spray equipment for application only when permitted by authorities having jurisdiction. Wherever spray application is used, do not double back with spray equipment to build up film thickness of two coats in one pass.

3.4 FIELD QUALITY CONTROL

A. Field Testing and Inspection: Owner reserves the right to engage the services of a qualified testing agency to verify installed thickness of elastomeric coatings.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

END OF SECTION

SECTION 09 9654 - POLYVINYLIDENE DIFLUORIDE (PVDF) COATING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Summary: Section includes shop-applied polyvinylidene difluoride (PVDF) exposed coil coated finish and extrusion coatings also known as high-performance organic finish, baked-on fluorocarbon finish, or special fluoropolymer finish as specified in other sections of this Specifications to include the coatings for work of the following:

1. Section 01 4339 "Exterior Walls Mockups".
2. Section 07 4113.13 - Formed Metal Roof Panels.
3. Section 07 4213.13 - Formed Metal Wall Panels.
4. Section 07 4213.23 - Metal Composite Material Wall Panels.
5. Section 07 6200 - Sheet Metal Flashing and Trim.
6. Section 08 4113 - Aluminum-Framed Entrances and Storefronts.
7. Section 08 4229.23 - Sliding Automatic Entrances.
8. Section 08 4413 - Glazed Aluminum Curtain Walls.
9. Section 08 9119 - Fixed Louvers.

PART 2 - PRODUCTS

2.1 POLYVINYLIDENE DIFLUORIDE (PVDF) RESIN

A. Manufacturers: Provide products by one of the following:

1. Arkema, Inc.; Kynar 500.
2. Solvay Solexis S.p.A; Hylar 5000.

B. PVDF Resin: Highly non-reactive and pure thermoplastic fluoropolymer; fine powder grade used as principal ingredient for high-performance coating system.

2.2 COATING MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Akzo Nobel.
2. BASF/Morton Industrial Coatings.
3. PPG Industries, Inc.
4. Valspar Corporation.

B. Applicators: Applicators approved and licensed by coating manufacturer.

2.3 COIL-COATED FINISH

A. Exposed-Coil-Coated Finish: High performance organic coatings complying with AAMA 620 for architectural aluminum and AAMA 621 for hot dipped galvanized (HDG) and zinc-aluminum coated steel substrates.

1. Two-Coat Fluoropolymer: Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Coating Products:
      1) PPG Duranar.
      2) Valspar Fluropon.
      3) BASF/Morton Fluoroceram.
      4) Azxo Nobel Trinar.
2. Three-Coat Fluoropolymer: Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Coating Products:
      1) PPG Duranar XL Plus.
      2) Valspar Fluropon.
      3) BASF/Morton Fluoroceram.
      4) Azxo Nobel Trinar.
3. Color: As selected by Architect from manufacturer's full range.

B. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.4 FLUOROPOLYMER PANEL AND EXTRUSION COATINGS

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Coating Products:

a. PPG Duranar.
b. Valspar Fluropon.
c. BASF/Morton Fluoroceram.
d. Azxo Nobel Trinar.

B. High-Performance Organic Finish: Three -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Coating Products:
   a. PPG Duranar XL.
   b. Fluropon Classic.

2.5 MISCELLANEOUS MATERIALS

A. Touch-up and Repair of PVDF Coatings: Two-component, fluoropolymer coating using 100 percent fluoroethylene alkyl vinyl ether (FEVE) resins and aliphatic isocyanate.

1. Coating Products:
   a. PPG Industries, Inc.; Duranar ADS System.
   b. Valspar Corporation; Fluropon ADS.

2.6 FLUOROPOLYMER COATINGS SHOP APPLICATION

A. Pretreatment: Chrome phosphate based pretreatment.

B. Methods: A system consisting of the primer and finish, each spray-applied by an approved applicator at the factory, force-cured in accordance with the coating manufacturers current printed instructions.

C. Fluorocarbon top finish color coating shall have a minimum baking cycle of 450 deg F for 20 minutes and shall have a minimum dry film thickness of 1.0 mil.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 09 9737 - DRY ERASE COATING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section specifies field-applied dry erase coatings including surface preparation and primer.

1.2 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies; gypsum board substrate.

B. Section 10 1100 - Visual Display Surfaces; whiteboard and chalkboard substrates.

1.3 SUBMITTALS

A. Comply with Division 01 Section: Submittals.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

C. Preparation instructions and recommendations.

D. Storage and handling requirements and recommendations.

E. Installation methods.

F. Maintenance Instructions: Provide precautions against cleaning materials and methods that may be detrimental to finish and performance.

G. Samples: Submit verification sample of specified color on manufacturer’s standard sample card.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 3 years manufacturing dry erase coatings.

B. Mock-ups: Prepare mock-ups for Architect's review and to establish requirements for substrate finish and final coating application, texture and color.

1. Install dry erase coatings mock-up in area designated by Architect.
2. Correct areas, modify method of application/installation, or adjust finish texture as directed by Architect to comply with specified requirements.
3. Maintain mock-ups accessible to serve as a standard of quality for this Section.
4. Accepted mock-ups may remain in place.

C. Sustainable Design:

1. Indoor Air Quality: UL GREENGUARD Gold Certified product.
2. USGBC LEED IEQ Credit 4.2 for Low-Emitting Materials - Paints and Coatings

3. Compliance achieved using 150 g/l VOC content threshold.
4. Provide coating meeting SCAQMD Rule 1113 Section (c)(1) requirements, default limit of 250g/l VOC.
5. Compliance achieved using CA 01350 indoor air emissions.
6. Compliance achieved using USGBC VOC Budget Methodology for low- emitting materials.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original factory wrappings and containers, clearly labeled with manufacturer, product name, and fire hazard classification.

B. Store materials in original undamaged packages and containers inside a well - ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Store at temperatures above 40 degrees F. Do not allow product to freeze.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperature not less than 50 deg F minimum and 85 deg F maximum 72 hours prior to beginning of installation.

B. Do not install dry erase coatings unless substrate temperature is above 60 degrees F.

C. Do not install dry erase coatings until the space is enclosed and weatherproof.

D. Do not install dry erase coatings until temperature is stabilized and permanent lighting is in place.

1.7 WARRANTY

A. Warranty: Manufacturer’s 10 year limited material warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturer: IdeaPaint, 40 Broad Street, 1st Floor, Boston, MA 02109, telephone 617-714-1050, fax 617-714-1080, website www.ideapaint.com.

2.2 PRODUCTS

A. Dry Erase Coating: CREATE by IdeaPaint, providing a surface suitable for use of dry erase markers.

B. Color: Specialty and Custom color as selected.

C. Fire Rating (ASTM E84): Class A, flame spread index 10, smoke developed index 20.

D. VOC (EPA Method 24): 18 g/L Part A and B mixed, 1.4 g/L Part A only, 97 g/L Part B only.

E. Solids: 98 percent Part A, 40 percent Part B.

F. Density: 12.18 lbs/gal Part A, 8.14 lbs/gal Part B.

G. Opacity/Hiding Power (ASTM D2805): 98.3 percent.

H. Sag Resistance (ASTM D4400 Method 6.5.6): 4.8.

I. Flow and Leveling (ASTM D2801): 6.

J. Crack Resistance (ASTM D522): 29 percent.

K. Finish/Gloss (ASTM D523) on Dry Wall Board:

1. 20 degrees: 22.4.
2. 60 degrees: 66.0.
3. 85 degrees: 66.8.

L. Scrub Resistance (ASTM D2486): Greater than 11,100 cycles.

M. Stain Removal/Washability (ASTM D3450): 94.9 percent.

N. Flashpoint (ASTM D92 Open Cup): Greater than 200 degrees F Part A, greater than 200 degrees F Part B.

O. QUV (following 500 hours of exposure, samples prepared on Kilz primed drywall) Control panel: L = 96.74, a = -1.02, b = 2.14. Test panel: L = 96.27, a = -1.44, b = 4.04. Delta E = 2.00.

P. Chemistry Type: A non isocyanate based coating.

Q. Primer: IdeaPaint PRIMER, Sherwin-Williams Multi-Purpose, PPG Seal Grip, Glidden Gripper or Kilz Premium. Visit http://learn.ideapaint.com/preferred-products for a complete list of primers.

1. Priming is required over stained surfaces for optimal hiding power, such as stained whiteboards or stained chalkboards.
2. Priming is required for surface color changes for optimal hiding power of original surface color.
3. Priming is required over new drywall, plastic, aluminum, steel (galvanized and ungalvanized), and vinyl.

R. Roller Covers: Provided by manufacturer. No substitutions.

PART 3 - **EXECUTION**

3.1 EXAMINATION

A. Examine areas and conditions in which dry erase coatings will be installed.

B. Complete finishing operations, including painting, before beginning installation of dry erase coatings.

C. Wall surfaces to receive dry erase coatings shall be dry and free from dirt, grease, loose paint, and scale.

D. Do not proceed with installations until unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Remove hardware, accessories, plates and similar items to allow dry erase coatings to be installed.

B. Repair damaged areas by filling voids with spackle. Sand smooth repaired or textured surfaces. Scuff glossy and non-porous surfaces using medium grit sandpaper. Paint product is a high gloss coating; imperfections and visible seams will telegraph.

C. Gypsum Board Surface: Provide Level 4 finish per ASTM C840 and GA-214. Recess nails and screws. Repair irregular tape joints, sand and remove dust.

D. Prime: Prime substrate using materials recommended by manufacturer if changing color of the surface, if covering a stained surface, or if applying on new drywall. Follow manufacturer's application, dry time, and recoat instructions prior to proceeding.

1. Changing color of the surface: Prime surface until the color of the existing surface does not show through.
2. Covering stained surface: Prime surface until undesired marks and stains do not show through.

E. Clean: Wipe surface with a clean, damp cloth to remove dust and environmental debris. Allow surface to completely dry.

F. Ventilate area thoroughly to aid in curing process and to dissipate mild odor. Allow a high percentage of outside air into current ventilation.

3.3 APPLICATION

A. Comply with manufacturers printed installation instructions. Mix components in strict accordance with manufacturer's instructions. Pot life is 1 hour maximum.

B. Apply dry erase coating with specified roller only. Comply with the following:

1. Apply heavy single coat only, using 2 layer method as described. Do not recoat or touch up applied coating once 10 minute return time has passed.
2. Divide your entire planned surface into areas up to 50 square feet.
3. Use a 4 inch foam roller to cut in all edges and light switches within the current area.
4. Using the included 9 inch roller, from one end of the current area to the other, apply in sections up to 4 feet wide by the full height of the surface.
5. Be sure to overlap the edges of each section and use a backrolling technique as you go to even out the application.
6. Watch for roller marks, drip marks, debris and missed spots, re-roll as needed.
7. Every 50 square feet or 3-5 minutes, return to the first section of the area you have just finished and apply the second layer using the same method detailed above. This helps to build up a thick and effective IdeaPaint surface.
8. Do not wait more than 10 minutes to perform the second layer over the first.
9. Remove masking tape within 1 hour of painting.

C. Dry erase coating may be applied directly onto clean, dry, smooth surfaces which are:
   1. A finished drywall surface
   2. A latex-based topcoat

D. Coating shall cure for a minimum of 4 days after application before use.

E. Application Rate: 5 mils wet film thickness as measured with a wet film gauge; maximum 50 square feet per quart or 200 square feet per gallon.

3.4 CLEANING AND MAINTENANCE

A. Regular erasing and cleaning should be done with a standard dry erase eraser or a dry microfiber towel. For more thorough cleaning, a damp microfiber towel may be used or IdeaPaint Cleaner.

B. If damaged, the original surface shall be deglossed by sanding surface and priming before recoating.

3.5 PROTECTION

A. Protect installed product and finished surfaces from damage during construction.

END OF SECTION

SECTION 10 1100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Visual display board assemblies.
2. Glass markerboards.
3. Magnetic glass markerboards.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Product Data for Credit EA 4: For recycled content, documentation indicating recycled content.

C. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
3. Include sections of typical trim members.

D. Samples for Verification: For each type of visual display unit indicated.

1. Accessories: Full-size Sample of each type of accessory.

E. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Provide the following upon request:

1. Qualification Data: For qualified Installer.

2. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of tackboards.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.9 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.

b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Claridge Products and Equipment, Inc.
2. Egan Visual Inc.
3. Marsh Industries, Inc.; Visual Products Group.
4. Peter Pepper Products, Inc. Basis of Design Tactics Plus Writing Surface

B. Visual Display Board Assembly: factory fabricated.

1. Assembly: markerboard.
2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.
5. Mounting Method: Panel hanger system .

C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.

1. Color: As selected by Architect from full range of industry colors.

D. Tackboard Panel: Vinyl-fabric-faced tackboard panel on core indicated.

1. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
2. Color and Pattern: As selected by Architect from full range of industry colors.

E. Aluminum Frames: Fabricated from not less than 0.062-inch- thick, extruded aluminum; slim size and standard shape.

1. Aluminum Finish: Manufacturer's standard baked-enamel or powder-coat finish.

F. Chalktray: Manufacturer's standard; continuous.

1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends. Magnetic type.

2.3 GLASS MARKERBOARDS

A. Magnetic Glass Markerboards: 5/16" tempered magnetic glass markerboard, with smooth polished edge and eased corners; color coated on back surface.

1. GlasPro-GL Magnetic glass.

B. Glass Markerboards: 5/16" tempered glass makerboard with smooth polished edge and eased corners; color coated on back surface.

1. Deko Markerboards.

C. Mounting: Round, stainless-steel standoffs, holding glass approximately 1 inch from wall surface; mounted in notches in standoffs at top and bottom edges of markerboard.

1. Color and Surface: See Interior Finish Material Legend on drawings.

2.4 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Face Sheet Thickness: 0.021 inch uncoated base metal thickness.
2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.5 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

C. Extruded Aluminum: ASTM B 221, Alloy 6063.

D. Clips: Manufacturer's standard Z-clip mounting system.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations

in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

3.3 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

C. Rail Support System: Install horizontal support rail at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall with fasteners at 12 inches o.c.

1. Mounting Height: 72 inches above finished floor to top of rail.

2. Hang visual display units on rail support system.

3.4 CLEANING AND PROTECTION

A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION

SECTION 10 1200 - DISPLAY CASES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bulletin boards.

B. Related Requirements:

1. Section 10 1100 "Visual Display Units" for tackboards.

1.3 DEFINITIONS

A. Bulletin Board: Glazed cabinet with tackboard panel, without shelves, typically of shallow depth for display of paper documents.

B. Tackboard Panel: A material for holding push-pins or tacks typically consisting of a facing; such as fabric, vinyl, or cork; adhered to a substrate; such as fiberboard, hardboard, particleboard.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for bulletin boards. Include furnished specialties and accessories.

B. LEED Submittals:

1. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that the product contains no urea formaldehyde.

3. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products used in bulletin boards, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Shop Drawings: For bulletin boards.

1. Include plans, elevations, sections, and attachment details.
2. Show location of seams and joints in tackboard panels.
3. Include sections of typical trim members.

D. Samples for Verification: For each type of exposed finish for the following.

1. Tackboard Panel: Not less than 8-1/2 by 11 inches, with facing and substrate indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch- long sections of each trim profile including corner section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For bulletin boards to include in maintenance manuals.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install bulletin boards for indoor installations until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of openings for and bulletin boards by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

2.2 BULLETIN BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Claridge Products and Equipment, Inc.
2. Laurence, C.R. Co., Inc.
3. Peter Pepper Products, Inc.
4. Vomar Products, Inc.

B. General: Factory-fabricated unit consisting of manufacturer's standard wall-mounted cabinet with tackboard panel on back inside surface and operable glazed doors at front.

1. Frame and Cabinet Profile: Square frame section with square cabinet corners.
2. Mounting: Surface mounted.
3. Size: As indicated on Drawings.

C. Aluminum-Framed Cabinet: Extruded aluminum; with manufacturer's standard baked-enamel or powder-coat finish.

D. Exterior Bulletin Boards: Aluminum-framed units of weather-resistant construction; with vents to dissipate trapped moisture, weather-resistant tackboard panel, and weather-stripped hinged doors.

E. Glazed Hinged Doors: Tempered glass; set in frame matching cabinet material and finish. Equip each door with full-height continuous hinge and cylinder lock with two keys.

1. Thickness: Not less than 5 mm thick.
2. Number of Doors: As indicated on Drawings.

2.3 TACKBOARD PANELS

A. Vinyl-Fabric-Faced Tackboard Panel <Insert designation>: Vinyl fabric factory laminated to 3/8-inch- thick fiberboard backing.

2.4 MATERIALS

A. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde., that complies with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Vinyl Fabric: FS CCC-W-408D, Type II, burlap weave; weighing not less than 13 oz./sq. yd.; with flame-spread index of 25 or less when tested according to ASTM E 84.

C. Extruded-Aluminum Bars and Shapes: ASTM B 221, Alloy 6063.

D. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

E. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

F. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FABRICATION

A. Fabricate bulletin boards to requirements indicated for dimensions, design, and thickness and finish of materials.

B. Use metals and shapes of thickness and reinforcing required to produce flat surfaces, and to impart strength for size, design, and application indicated.

C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper backing for .

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

1. Mounting Height: 72 inches above finished floor to top of cabinet.

B. Bulletin Boards: Attach units to wall surfaces with concealed clips, hangers, or grounds.

3.3 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

B. Touch up factory-applied finishes to restore damaged areas.

END OF SECTION

SECTION 10 1419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fabricated channel dimensional characters.

1.3 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
    a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For dimensional letter signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
4. Show locations of electrical service connections.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: Full-size Sample of each type of dimensional character.

2. Exposed Accessories: Full-size Sample of each accessory type.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

F. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with the University's Campus Sign Program requirements.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Provide the following upon request:

1. Qualification Data: For Installer.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of finishes beyond normal weathering.
   b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design sign structure and anchorage of dimensional character sign type(s) to withstand design loads as indicated on Drawings.

B. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 DIMENSIONAL CHARACTERS

A. Fabricated Channel Characters : Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.

1. Character Material: Sheet or plate stainless steel.
2. Material Thickness: Manufacturer's standard for size and design of character.
3. Character Height: As indicated.
4. Character Depth: As indicated.
5. Finishes:
    a. Integral Stainless-Steel Finish: No. 4.
6. Mounting: Manufacturer's standard for size and design of character .
    a. Hold characters at manufacturer's recommended distance from wall surface.

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
2. Exposed Metal-Fastener Components, General:
    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

b. Fastener Heads: For nonstructural connections, use oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.

3. Sign Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.

4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

5. Internally brace signs for stability and for securing fasteners.

6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Stainless-Steel Brackets: Factory finish brackets with No. 4 finish unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that electrical service is correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10 1423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Panel signs.
2. Room-identification signs.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
    a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Full-size Sample .
2. Room-Identification Signs: Full-size Sample.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Comply with University's Campus Sign Program requirements.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Provide the following upon request:

1. Qualification Data: For Installer.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of finishes beyond normal weathering.
   b. Deterioration of embedded graphic image.
   c. Separation or delamination of sheet materials and components.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the 2010 ADA Standards and 2016 CBC 10 and 11B for signs.

2.2 SIGNS

A. Panel Sign : Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Solid-Sheet Sign and Returns: Acrylic sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph below and as follows:
   a. Thickness: 0.125 inch.
   b. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
2. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.
3. Mounting: Surface mounted to wall with two-face tape .
4. Surface Finish and Applied Graphics:
   a. Integral Acrylic Sheet Color: As selected by Architect from full range of industry colors.
5. Text and Typeface: Accessible raised characters and Braille. Finish raised characters to contrast with background color, and finish Braille to match background color.
6. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

B. Room-Identification Sign : Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
   a. Composite-Sheet Thickness: 0.25 inch.
   b. Color(s): As selected by Architect from manufacturer's full range.
2. Sign-Panel Perimeter: Finish edges smooth.
   a. Edge Condition: .
   b. Corner Condition in Elevation: Square.
3. Mounting: Surface mounted to wall with two-face tape.
4. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range . Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 PANEL-SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION

A. Comply with requirements of CBC 2016 11B.703.2 for signage fabrication.

B. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Internally brace signs for stability and for securing fasteners.

C. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.

1. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with CBC 11B.703.4 requirements for mounting signage.

B. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.

D. Mounting Methods:

1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

E. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10 2113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for supports that attach ceiling-hung compartments to overhead structural system.
2. Section 06 1053 "Miscellaneous Rough Carpentry" for blocking.
3. Section 10 2800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

D. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.

E. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch- square Samples of same thickness and material indicated for Work.

2. Each type of hardware and accessory.

F. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the 2010 ADA Standards and 2016 CBC 11B.604 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARMENTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Accurate Partitions Corporation.

2. Bobrick Washroom Equipment, Inc.

3. Bradley Corporation; Mills Partitions.

4. Partition Systems Incorporated of South Carolina; Columbia Partitions.

B. Toilet-Enclosure Style: Ceiling hung.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- thick doors and pilasters and minimum 1/2-inch- thick panels.

E. Pilaster Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

F. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

G. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.
2. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard dark color core.
3. Edge Color: Manufacturer's standard.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- thick stainless-steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through-bolts.
2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
6. Comply with 2013 CBC 11B.309.4.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for

through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

B. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.
2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

SECTION 10 2123 - CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Curtain tracks and carriers.
2. Cubicle curtains.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for supplementary wood framing and blocking for mounting items requiring anchorage.
2. Section 09 2216 "Non-Structural Metal Framing" for supplementary metal framing and blocking for mounting items requiring anchorage.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include durability, laundry temperature limits, fade resistance, applied curtain treatment, and fire-test-response characteristics for each type of curtain fabric indicated.
2. Include data for each type of track.

C. Shop Drawings:

1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
2. Include details on blocking above ceiling and in walls.

D. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:

1. Curtain Fabric: 10-inch- square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.

2. Curtain Track: Not less than 10 inches long.

3. Curtain Carrier: Full-size unit.

E. Curtain and Track Schedule: Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For curtains, track, and hardware to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Curtains: Provide curtain fabrics with the following characteristics:

1. Launderable to a temperature of not less than 160 deg F .

2. Flame resistant and identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.

a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CURTAIN SUPPORT SYSTEMS

A. Extruded-Aluminum Curtain Track: Not less than 1-1/4 inches wide by 3/4 inch high ; with 0.062-inch minimum wall thickness.

1. Curved Track: Factory-fabricated, 12-inch- radius bends.

2. Finish: Satin anodized.

B. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

1. Suspended-Track Support: Not less than 7/8-inch- OD tube.

2. End Stop: Removable with carrier hook.

3. Switch Unit: Shuttle and coupling device for rerouting and securing cubicle curtain, with pull chain for switching track.

C. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.

D. Exposed Fasteners: Stainless steel.

E. Concealed Fasteners: Stainless steel.

2.3 CURTAINS

A. Cubicle Curtain Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.

B. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.

C. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.4 CURTAIN FABRICATION

A. Continuous Curtain Panels:

1. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches added fullness.

2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor as follows:

a. Cubicle Curtains: 12 inches .

b. Blackout Curtains:

3. Top Hem: Not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched.

4. Bottom Hem: Not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced, and double lockstitched.

5. Side Hems: Not less than 1/2 inch and not more than 1-1/4 inches wide, with triple turned edges, and single lockstitched.

6. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install tracks level and plumb, according to manufacturer's written instructions.

B. Up to 20 feet in length, provide track fabricated from single, continuous length.

1. Curtain Track Mounting: As indicated on Drawings.

C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:

1. Mechanically fasten directly to bottom of concrete deck with post-installed anchors.

2. Mechanically fasten directly to finished ceiling with toggle bolts.

3. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
4. Mechanically fasten to suspended ceiling grid with screws.
5. Attach track to suspended ceiling grid with manufacturer's proprietary clip.

D. Suspended-Track Mounting: Install track with manufacturer's standard tubular aluminum suspended supports at intervals and with fasteners recommended by manufacturer. Fasten supports to structure. Provide supports at each splice and tangent point of each corner. Secure ends of track to wall with flanged fittings or brackets.

E. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

F. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.

G. Cubicle Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

END OF SECTION

SECTION 10 2213 - WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wire mesh equipment barriers.

1.3 DEFINITIONS

A. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.

B. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.

2. Indicate clearances required for operation of doors and gates.

E. Delegated-Design Submittal: For wire mesh partitions indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wire mesh partition hardware to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: [Fabricator of products] [An employer of workers trained and approved by manufacturer].

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Provide the following upon request:

1. Qualification Data: For Installer.
2. Welding certificates.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project-site storage. Use vented plastic.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acorn Wire & Iron Works, LLC.
2. California Wire Products Corporation.
3. Kenco Wire and Iron Products Inc.
4. SpaceGuard Products.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design wire mesh units.

B. Structural Performance: Wire mesh units shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft. at any location on a panel.
2. Total load of 200 lbf applied uniformly over each panel.
3. Concentrated load and total load need not be assumed to act concurrently.

C. Seismic Performance: Wire mesh units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Wire: ASTM A 510.

C. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.

D. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

E. Steel Tubing: ASTM A 500/A 500M, cold-formed structural-steel tubing or ASTM A 513, Type 5, mandrel-drawn mechanical tubing.

F. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.

G. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.

H. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components are zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

I. Power-Driven Fasteners: ICC-ES AC70.

J. Seismic Bracing: Angles with legs not less than 1-1/4 inch wide, formed from 0.040-inch-thick, metallic-coated steel sheet; with bolted connections and 1/4-inch- diameter bolts.

K. Low-Emitting Coatings: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 WIRE MESH EQUIPMENT BARRIERS

A. Mesh: 0.135-inch- diameter, intermediate-crimp steel wire woven into 1-1/2-inch diamond mesh.

B. Panels: 1-1/4-by-1-1/4-by-1/8-inch steel angle framing on four sides, with wire mesh welded to framing.

1. Horizontal Panel Stiffeners: 1-1/4-by-1-1/4-by-1/8-inchsteel angles or 3/4-by-1/4-inch hot-rolled steel flat bars.

2. Height: 60 inches.

C. Line and Corner Posts: 2-by-2-by-0.068-inch steel tubing with steel base plates welded to bottoms, drilled for attachment to floor, and with steel caps welded to tops.

1. Height: Panel height plus 12-inch- high, sweep space.

D. Finish for Uncoated Ferrous Steel: Hot-dip galvanized Powder-coated finish unless otherwise indicated.

1. Color: As indicated by manufacturer's designations.

2.5 FABRICATION

A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.

1. Fabricate wire mesh items to be readily disassembled.

2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

B. Heavy-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh: Weld mesh to framing.

2. Framing: Fabricate framing with mortise and tenon corner construction.

a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.

b. Fabricate partition and door framing with slotted holes for connecting adjacent panels.

3. Fabricate wire mesh partitions with 3 to 4 inches of clear space between finished floor and bottom horizontal framing.

2.6 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

B. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where wire mesh items will be installed.

C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRE MESH PARTITIONS ERECTION

A. Anchor wire mesh partitions to floor with 3/8-inch- diameter postinstalled expansion anchors at 12 inches o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.

1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.

B. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:

1. For concrete and solid masonry anchorage, use expansion anchors.

2. For steel-framed gypsum board assemblies, use lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

C. Secure top capping bars to top framing channels with 1/4-inch- diameter "U" bolts spaced not more than 28 inches o.c.

D. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

E. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.

F. Install doors complete with door hardware.

3.3 WIRE MESH EQUIPMENT BARRIER ERECTION

A. Anchor wire mesh equipment barriers to floor with 3/8-inch- diameter expansion anchors through post bases. Shim post bases as required to achieve level and plumb installation.

B. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.

3.4 ADJUSTING AND CLEANING

A. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.

END OF SECTION

SECTION 10 2239.13 - FOLDING GLASS-PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes manually operated, glass-panel partitions.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.

1.3 DEFINITIONS

A. STC: Sound Transmission Class.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Certificates for Credit MR 7: Chain-of-custody certificates certifying that operable glass-panel partitions comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.

C. Shop Drawings: For operable glass-panel partitions.

1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.

2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:

1. Panel Edge Material: Not less than 3 inches long.
2. Glass: Units 12 inches square.
3. Hardware: One of each exposed door-operating device.

E. Delegated-Design Submittal: For operable glass-panel partitions.

1. Include design calculations for seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Partition track, track supports and bracing, switches, turning space, and storage layout.
2. Suspended ceiling components.
3. Structural members to which suspension systems are attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
   a. Lighting fixtures.
   b. HVAC ductwork, outlets, and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Smoke detectors.
   f. Access panels.
6. Plenum acoustical barriers.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable glass-panel partitions to include in maintenance manuals.

1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:
   a. Panel finish and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
   b. Seals, hardware, track, track switches, carriers, and other operating components.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

D. Provide the following upon request:

1. Setting Drawings: For embedded items and cutouts required in other work[, including support-beam, mounting-hole template].

2. Qualification Data: For qualified Installer.

3. Seismic Qualification Certificates: For operable glass-panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:

a. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.

b. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.

4. Product Certificates: For each type of operable glass-panel partition.

5. Product Test Reports: For each operable glass-panel partition, for tests performed by a qualified testing agency.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable glass-panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of operable glass-panel partitions.

b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design seismic bracing of tracks to structure above.

B. Seismic Performance: Operable glass-panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."

2.2 OPERABLE GLASS PANELS

A. Operable Glass Panels: Frameless aluminum glass-panel partition system, including panels, suspension system, operators, and accessories.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avanti.
   b. Hufcor, Inc.
   c. KWIK-WALL Company.
   d. Moderco Inc.
   e. Modernfold, Inc.; a DORMA Group company.
   f. NanaWall Systems, Inc.

B. Panel Operation: Manually operated, individual panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

1. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written instructions and with requirements in Section 08 8000 "Glazing."

D. Glass and Glazing: As follows:

1. Safety Glass Standard for Partition Panels: Provide glass products complying with testing requirements in 16 CFR 1201, Category II, or ANSI Z97.1, Class A.

2. Glass: Manufacturer's standard safety glass and glass assemblies as indicated and complying with the following:
   a. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Type I (transparent flat glass), Class 1 (clear), Quality-Q3.
   b. Glass Thickness: As indicated.
   c. Glass Vertical Edge: Polished.

3. Glazing System: Manufacturer's standard factory-glazing system that produces acoustical seal.

E. Dimensions: Fabricate operable glass-panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: As indicated.

F. STC: Not less than 36.

G. Panel Closure: Manufacturer's standard unless otherwise indicated.

H. Hardware: Manufacturer's standard as required to operate operable glass-panel partition and accessories; with decorative, protective finish.

1. Floor Lock: Thumb-turn actuated.

I. Panel Frame Finishes:

1. Exposed Metal: As selected by Architect from manufacturer's full range as follows:

a. Metal-Clad Aluminum: Satin stainless steel.

2.3 SEALS

A. General: Provide seals that produce operable glass-panel partitions complying with performance requirements and the following:

1. Manufacturer's standard seals unless otherwise indicated.

2. Seals made from materials and in profiles that minimize sound leakage.

3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable glass-panel partition perimeter and adjacent surfaces, when operable glass-panel partition is extended and closed.

2.4 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable glass-panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable glass-panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.

2. Head Closure Trim: As required for acoustical performance; primed for field finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

1. Multidirectional Carriers: Capable of negotiating intersections without track switches.

C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable glass-panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.

2. L Intersections: Allow panels to change 90 degrees in direction of travel.

3. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.

4. X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.

5. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.

6. Center carrier stop.

D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.5 ACCESSORIES

A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same frame material, finish, thickness, and acoustical qualities as panels; complete with operating hardware. Hinges in finish to match other exposed hardware.

1. Manufacturer's standard method to secure storage pocket door in closed position.

2. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.

B. Vertical Edge Trim: Manufacturer's standard transparent trim to protect vertical edges of glass in frameless panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable glass-panel partitions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by operable glass-panel partition manufacturer's written installation instructions.

B. Install operable glass-panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.3 ADJUSTING

A. Adjust operable glass-panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

3.4 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable glass-panel partitions.

END OF SECTION

SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Stainless Steel Wall guards.
2. Corner guards.
3. Impact-resistant wall coverings.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: Include construction details, material descriptions, impact strength , fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.4: For particleboard, documentation indicating that products contain no urea formaldehyde.
3. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Wall and Corner Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.
2. Impact-Resistant Wall Covering: 6 by 6 inches square.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 01 4000 "Quality Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

E. Preinstallation Conference: Conduct conference at Project site.

F. Provide the following upon request:

1. Qualification Data: For qualified Installer.
2. Material Certificates: For each impact-resistant plastic material, from manufacturer.
3. Material Test Reports: For each impact-resistant plastic material.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.

2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
    a. Store corner-guard covers in a vertical position.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
    1. Failures include, but are not limited to, the following:
        a. Structural failures.
        b. Deterioration of plastic and other materials beyond normal use.
    2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; extruded and sheet material, thickness as indicated.
    1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
    2. Chemical and Stain Resistance: Tested according to ASTM D 543 .
    3. Self-extinguishing when tested according to ASTM D 635.
    4. Flame-Spread Index: 25 or less.
    5. Smoke-Developed Index: 450 or less.

B. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 for Alloy 6063-T5.

C. Stainless-Steel Sheet: ASTM A 240/A 240M.

D. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.2 WALL GUARDS

A. Bumper Rail : Assembly consisting of continuous stainless steel rail with extruded aluminum retainer; designed to withstand impacts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Life Science Products, Inc. Sani-Rail.
2. Continuous Rail: Minimum 0.125-inch- thick, one-piece, Type 304, stainless steel rail, with No. 4 finish.
3. Retainer Clips: Manufacturer's standard aluminum impact-absorbing clips.
4. Mounting: Surface mounted directly to wall .

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards : Fabricated from one-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Arden Architectural Specialties, Inc.
   b. Construction Specialties, Inc.
   c. Life Science Products, Inc.
   d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
2. Material: Stainless steel, Type 304.
   a. Thickness: Minimum 0.0625 inch.
   b. Finish: Directional satin, No. 4.
3. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
4. Corner Radius: 1/8 inch.
5. Mounting: **Adhesive.**

2.4 IMPACT-RESISTANT WALL COVERINGS

A. Impact-Resistant Sheet Wall Covering : Fabricated from plastic sheet wall-covering material.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Arden Architectural Specialties, Inc.

b. Construction Specialties, Inc.

c. IPC Door and Wall Protection Systems; Division of InPro Corporation.

d. Korogard Wall Protection Systems; a division of RJF International Corporation.

2. Size: 48 by 96 inches for sheet.

3. Sheet Thickness: 0.040 inch.

4. Color and Texture: As selected by Architect from manufacturer's full range.

5. Height: Wainscot.

6. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.

7. Mounting: Adhesive.

2.5 FABRICATION

A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Remove tool and die marks and stretch lines, or blend into finish.

2. Grind and polish surfaces to produce uniform finish, free of cross scratches.

3. Run grain of directional finishes with long dimension of each piece.

4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Childcare accessories.
4. Underlavatory guards.
5. Custodial accessories.

B. Related Requirements:

1. Section 09 3013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

A. See Drawings for Toilet Accessory Schedule.

2.2 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain Rod :

1. Description: 1-1/4-inch OD; fabricated from nominal 0.05-inch- thick stainless steel.
2. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
3. Finish: Stainless steel, No. 4 finish (satin).

B. Shower Curtain :

1. Size: Minimum 12 inches wider than opening by 72 inches high.
2. Material: Nylon-reinforced vinyl, minimum 10 oz. or 0.008-inch- thick vinyl, with integral antibacterial agent.
3. Color: White.
4. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
5. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

C. Folding Shower Seat :

1. Configuration: Rectangular seat.
2. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.

3. Mounting Mechanism: Stainless steel, No. 4 finish (satin).

D. Robe Hook :

1. Description: Double -prong unit.
2. Material and Finish: Stainless steel, No. 4 finish (satin).

2.3 CHILDCARE ACCESSORIES

A. Diaper-Changing Station :

1. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
   a. Engineered to support minimum of 250-lb static load when opened.
2. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
3. Operation: By pneumatic shock-absorbing mechanism.
4. Material and Finish: HDPE in manufacturer's standard color.
5. Liner Dispenser: Built in.

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard :

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder :

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches.
3. Hooks: Four.
4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No. 4 finish (satin).
   a. Rod: Approximately 1/4-inch- diameter stainless steel.

2.6 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION

SECTION 10 4413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:
    a. Portable fire extinguishers.

B. Related Requirements:

1. Section 10 4416 "Fire Extinguishers."

1.3 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

1. Show location of knockouts for hose valves.

C. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.

E. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.7 SEQUENCING

A. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Guardian Fire Equipment, Inc.
    b. JL Industries, Inc.; a division of the Activar Construction Products Group.
    c. Larsens Manufacturing Company.
    d. Nystrom, Inc.
    e. Potter Roemer LLC.

B. Cabinet Construction: Nonrated

C. Cabinet Material: Cold-rolled steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

E. Cabinet Trim Material: Steel sheet .

F. Door Material: Steel sheet.

G. Door Style: Flush opaque panel, frameless, with no exposed hinges.

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.

2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

I. Accessories:

1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
   a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
      1) Location: Applied to cabinet glazing.
      2) Application Process: Decals.
      3) Lettering Color: Red.
      4) Orientation: Vertical.

J. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
   a. Finish: Factory primed for field painting.

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below: or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.
2. Ensure that cabinet handle and top of fire extinguishers are mounted no higher than 48 inches above finished floor.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.

C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10 4416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 10 4413 "Fire Protection Cabinets."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Failure of hydrostatic test according to NFPA 10.

b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation. B500 (Campus Standard)

2. Valves: Nickel-plated, polished-brass body.

3. Handles and Levers: Stainless steel.

4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 48 inches above finished floor to top of fire extinguisher.

2. Do not install brackets in fire protection cabinets.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 10 5119 - PHENOLIC CORE LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes phenolic core lockers and benches.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of phenolic core locker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker and bench.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
    a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
3. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
4. Product Data for Credit IEQ 4.4: For adhesives and composite products, documentation indicating that products contain no urea formaldehyde.

5. Laboratory Test Reports for Credit IEQ 4.4: For composite products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings: For phenolic core lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show details full size.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in lockers.
5. Show locker fillers, trim, base, sloping tops, and accessories.
6. Show locker numbering sequence.

E. Samples for Verification: For the following products:

1. Phenolic core panels, not less than 8 by 10 inches, for each type, color, pattern, and surface finish.
2. Corner pieces of locker front frame joints between stiles and rail, as well as exposed end pieces, not less than 18 inches wide by 18 inches high by 6 inches deep.
3. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Provide the following upon request:

1. Qualification Data: For qualified Installer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of concealed support bases.

1. Requirements are specified in Section 06 1053 "Miscellaneous Rough Carpentry."

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Faulty operation of locks or hardware.
   c. Deterioration of and other materials beyond normal use.
2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the 2010 ADA Standards and CBC 11B.

2.2 PLASTIC-LAMINATE-CLAD WOOD LOCKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASI Storage Solutions
2. Clubline Lockers
3. General Partitions Manufacturing Corp.

4. List Industries.
5. PSISC.

B. Construction Style: Flush overlay.

C. Locker Body: Fabricated from solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges.

1. Side Panels: 3/4 3/8 inch thick.
2. Back Panel: 3/4 5/16 inch thick.
3. Top Panel: 3/4 3/8 inch thick.
4. Bottom Panel: 3/4 3/8 inch thick.

D. Phenolic Core-Clad Doors: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges..

1. Thickness: 3/4 1/2 inch thick.

E. End Panels: Match style, material, construction, and finish of phenolic core doors.

F. Corners and Filler Panels: 3/4-inch- thick panels. Match style, material, construction, and finish of phenolic core doors.

G. Continuous Finish Base: Phenolic core, 3/4-inch- thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.

H. Continuously Sloping Tops: Phenolic core, 3/4 1/2-inch- thick panel that matches door faces for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures, as follows:

1. Closures: Hipped-end type.
2. Sloping-top corner fillers, mitered.

I. Phenolic-Panel Finish:

1. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard dark color core.
2. Edge Color: Manufacturer's standard.

2.3 MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Soft or hard lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Wood Support Base: 2-by-4-inch nominal-size lumber treated with manufacturer's standard preservative-treatment, pressure process.

2.4 HARDWARE

A. General: Provide manufacturer's standard locker hardware complying with the requirements in this Section.

B. Cam Padlock Hasp: Surface mounted, steel; finished to match other locker hardware.

C. Frameless Hinges (European Type): Fully concealed, self-closing, nickel-plated steel, with not less than 125 degrees of opening.

~~D.~~ Wire Pulls: Back mounted; Manufacturers standard . 5 inches ~~long,~~ 2-1/2 inches ~~deep, and~~ 5/16 inch ~~in diameter.~~

E. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

F. Hooks: Manufacturer's standard, stainless j-hooks ~~ball-pointed aluminum or steel; epoxy coated~~. Attach hooks with at least two fasteners.

G. Exposed Hardware Finishes: Unless otherwise indicated, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

2.5 ACCESSORIES

A. Number Plates: 1-1/2-inch- diameter, etched, embossed, or stamped, stainless-steel plates with black numbers and letters at least 1/2 inch high. Identify lockers in sequence indicated on Drawings. Finish plates to match other locker hardware.

2.6 BENCHES

A. Pedestal-Leg Locker Benches: Bench supported by pedestal legs, minimum of two pedestals for each bench, with overall height of 18 inches measured from top of bench to floor, as follows:

1. Metal Pedestal Legs: 1-1/2-inch- square, painted steel tube.
2. Bench Tops: 1-1/4 inches deep; fabricated as follows:
   a. Butcher Block Top: Solid laminated hard.
   b. Width: 17 inches.
   c. Length: As Indicated .

2.7 FABRICATION

A. Fabricate each locker, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate lockers to dimensions, profiles, and details indicated.
2. Ease edges of corners of solid- members to 1/16-inch radius.

B. Fabricate components square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately factory machine components for attachments. Make joints tight and true.

1. Fabricate lockers using manufacturer's standard construction, with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.
2. Fabricate lockers with joints that are mortise and tenon ~~dadoed or rabbeted~~, glued full length, and stapled. Dado side panels to receive shelving except where indicated to be adjustable.
3. Join drawer subfronts, backs, and sides with manufacturer's standard glued joints.
4. Join drawer subfronts, backs, and sides with mortise and tenon ~~glued rabbeted joints supplemented by mechanical fasteners~~ or glued dovetail joints.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

D. Venting: Fabricate lockers with space between doors and locker assembly of not less than 1/4 inch .

E. Number Plates: Inlay number plates flush in each locker door, near top, centered.

F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

G. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install support base with 1/2-inch- thick ply top.

B. Assemble knocked-down lockers with manufacturer's standard fasteners, with no exposed fasteners on face frames.

C. Install lockers level, plumb, and true; use concealed shims.

D. Connect groups of lockers together with manufacturer's standard brass-finished fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

E. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inchsag, bow, or other variation from a straight line. Shim as required with concealed shims.

F. Locker Anchorage: Fasten lockers through locker base, at ends, and not more than 36 inches o.c. with No. 8 brass-finished, flush-head screws sized for 1-inch penetration into base.

G. Locker Anchorage: Fasten lockers through back, near top and bottom, at ends with No. 8 pan-head sheet metal screws through metal backing or metal framing behind wall finish and spaced not more than 16 inches o.c.

H. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

I. Attach sloping-top units to lockers, with end panels covering exposed ends.

J. Install number plates after lockers are in place.

1. Attach number plate on each locker door, near top, centered, with at least two screws with finish matching number plate.

K. Anchor locker benches to floors.

1. Uniformly space pedestals not more than 72 inches apart; securely fasten pedestals to bench top and anchor to floor.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Verify that integral locking devices operate properly.

B. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

C. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 11 1233 - PARKING GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. High performance barrier gate operator and accessories.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete mounting pads.

B. Division 16 - Requirements for electrical connections.

1.3 REFERENCES

A. Underwriters' Laboratory (UL): Categories FDDR and FDDR7 - Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Equipment list, system description, electrical wiring diagrams for installation, and manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, edge conditions, and accessories.
   1. Operation, installation, and maintenance manuals including wiring diagrams.
   2. Risers, layouts, and special wiring diagrams showing any changes to standard drawings

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

B. Schedule delivery of parking control equipment so that spaces are sufficiently complete that operators can be installed upon delivery.

1.6 QUALITY ASSURANCE

A. Perform installation by factory authorized contractor specifically trained in gate operation systems of the type found within this section.

B. Provide documentation of maintenance and repair service availability for emergency

conditions.

C. Provide quarterly maintenance for one year following Substantial Completion of the Project.

1.7 WARRANTY

A. Manufacturer's standard warranty for two years or 2 million cycles.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 HIGH PERFORMANCE BARRIER GATE OPERATOR

A. Magnetic Automation Corp MIB 10 Super High Speed Barrier Gate Operator: Barrier open/close time 0.6 seconds, 100% duty cycle, boom length up to 10 feet.

B. Magnetic Automation Corp MIB 20 High Speed Barrier Gate Operator: Barrier open/close time 0.9 seconds, 100% duty cycle, boom length up to 10 feet.

C. Magnetic Automation Corp MIB 30 High Speed Barrier Gate Operator: Barrier open/close time 1.4-1.9 seconds, 100% duty cycle, boom length up to 12 feet.

D. Magnetic Automation Corp MIB 40 High Speed Barrier Gate Operator: Barrier open/close time 4.0 seconds, 100% duty cycle, boom length up to 20 feet.

E. UL Classification:
   1. Conforms to UL Category FDDR - Door, Drapery, Gate, Louver and Window Operators and Systems Certified
   2. Conforms to UL Category FDDR7 - Door, Drapery, Gate, Louver and Window Operators and Systems Certified for Canada

F. Housing: Manufactured from 14 gauge steel onto steel base, then phosphate and powder coated for maximum protection against corrosion and superior durability.

G. Drive Unit:
   1. MIB 10: 1056.5035 100% duty cycle spring-balanced brushless DC servo motor providing 0.6-3.0sec open/close in excess of 2 million cycles; maximum arm length 10 feet; left- or right-hand operation.
   2. MIB 20: BDU20*-C900 100% duty cycle spring-balanced AC torque motor providing 0.9sec open/close time in excess of 2 million cycles; maximum arm length 10 feet; left- or right-hand operation.
   3. MIB 30: BDU30*-C900 100% duty cycle spring-balanced AC torque motor providing 1.4-1.9sec open/close time in excess of 2 million cycles; maximum arm length 12 feet; left- or right-hand operation.

4. MIB 40: BDU40*-C900 100% duty cycle spring-balanced AC torque motor providing 4.0sec open/close time in excess of 2 million cycles; maximum arm length 20 feet; left- or right-hand operation.

H. Controller:
1. MIB 10: MLC90-C100 Magnetic Lane Controller, two potential free inputs to open and close barrier and one safety device (i.e. photoelectric beams, safety loop, etc) input, two relay outputs for gate position feedback (open/close), one relay output for error indication.
2. MIB 20: MLC11-U100 Magnetic Lane Controller with built-in dual channel vehicle loop detectors, (5) potential free inputs and (2) 24V DC outputs, easy to program lane configurations and operation parameters via selector switch, push buttons and LCD display.
3. MIB 30/40: MLC10-U100 Magnetic Lane Controller with built-in dual channel vehicle loop detectors, (5) potential free inputs and (2) 24V DC outputs, easy to program lane configurations and operation parameters via selector switch, push buttons and LCD display.

I. Additional Required Controls:
1. Low power consumption and high MCBF (> 2,000,000 cycles).
2. Direct drive operation resulting in condensation/corrosion resistance, extremely low maintenance, ability to be stalled in any position without risk of damage, problem-free operation in cold climatic conditions and overall extended service life – no belts, pulleys or chains.
3. Modular construction with drive unit mounted to a heavy duty casting allowing easy access door to be mounted on any side of barrier.
4. Built-in position sensors (no limit switches) providing precise arm position status and a self-learning control unit to guarantee optimum braking and no boom arm bouncing, sagging or rotating out of position.
5. Easy to program controller for common lane configurations.
6. Knox key switch, submastered to campus.
7. Interface to building fire arm, open on alarm.

J. Gate Arm:

1. Arm: 15 foot octagonal aluminum arm (requires pendulum support or support pillar).
2. Arm: 20 foot octagonal aluminum arm.

K. Optional Equipment:
1. RS232/422/485 or TCP/IP communication for MIB20, MIB30 or MIB40.
2. Single channel vehicle loop detector.
3. Dual channel vehicle loop detector.
4. Additional foam protection inserted on the bottom of octagonal aluminum boom for extra safety.
5. Swing away flange
6. Wood arm flange adaptor (wood boom supplied by customer).
7. Pendulum support for boom arm lengths over 14 feet.

8. Contact for release of barrier arm
9. Additional I/O extension module.
10. Custom RAL color.
11. Boom arm lights with controller.
12. Support pillar in RAL 2000 Orange.
13. Support pillar in RAL 2000 Orange with electro-mechanical arm lock and control unit.
14. Additional heater for extremely cold environments.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions including the following:
1. Mount directly to concrete pad, firmly secured, plumb and level.
2. Mount to mounting pedestal; provide base plate.
3. Wire in accordance with National Electric Code.
4. Enclose all splices in easily accessible junction boxes or on terminal boards.
5. Tag and identify all cable runs in all junction boxes.

B. Test system and adjust to assure components and accessories are properly connected and in working order.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 MAINTENANCE

A. Maintain at three-month intervals during specified maintenance period, primarily checking rubber end stops on direct drive unit.

END OF SECTION

SECTION 11 1313 - LOADING DOCK BUMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes loading dock bumpers.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of loading dock bumper.

C. Shop Drawings: For dock bumpers. Include plans, elevations, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 DOCK BUMPERS

A. General: Surface-mounted bumpers; of type, size, and construction indicated; designed to absorb kinetic energy and minimize damage to loading dock structure.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Kelley; 4Front Engineered Solutions, Inc.
    b. Rite-Hite Holding Corporation.
    c. Serco; 4Front Engineered Solutions, Inc.

B. Laminated-Tread Dock Bumper : Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch-diameter, steel supporting rods that are welded at one end to 1/4-inch- thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch of tread plies extending beyond the face of closure angles.

1. Thickness: 6 inches.
2. Horizontal Style: 10 inches high by length indicated on Drawings.

C. Anchorage Devices: Galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated. Hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.

D. Materials: ASTM 36/A 36M for steel plates, shapes, and bars. Hot-dip galvanize according to ASTM A 123/A 123M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.

1. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.

3.3 ADJUSTING

A. After completing installation of exposed, factory-finished dock bumpers, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 11 1319 - STATIONARY LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Recessed dock levelers.
2. Edge-of-dock levelers.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for curb angles at edges of recessed pits andloading dock platform edge channels.
4. Section 11 1313 "Loading Dock Bumpers" for loading dock bumpers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
2. Review sequence of operation for each type of loading dock equipment.
3. Review coordination of interlocked equipment specified in this Section and elsewhere.
4. Review required testing, inspecting, and certifying procedures.

1.4 DEFINITIONS

A. Operating Range: Maximum amount of travel above and below the loading dock level.

B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

1.5 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for stationary loading dock equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For stationary loading dock equipment.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and field connection.
3. Include diagrams for power, signal, and control wiring.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For stationary loading dock equipment to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Provide the following upon request:

1. Qualification Data: For Installer.
2. Welding certificates.
3. Product Test Reports: For each dock leveler, for tests performed by manufacturer and witnessed by a qualified testing agency.
    a. Indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity, which is based on comprehensive testing within last two years of current products.
    b. Submittal Form: According to MH 30.1.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with stationary loading dock equipment, including recessed pit dimensions and heights of loading docks, by field measurements before fabrication.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace dock levelers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.

b. Faulty operation of operators, control system, or hardware.

c. Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch between deck supports.

d. Hydraulic system failures including failure of hydraulic seals and cylinders.

2. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.

3. Warranty Period for Hydraulic System: Five years from date of Substantial Completion.

4. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 RECESSED DOCK LEVELERS

A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

n. Serco Hydraulic Model HFC8740:18-SBL ; 4Front Engineered Solutions, Inc.

o. Or approved equal.

B. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.

C. Rated Capacity: Capable of supporting total gross load of <Insert load> without permanent deflection or distortion.

D. Platform: Not less than 1/4-inch- thick, nonskid steel plate.

1. Platform Size: As indicated on Drawings.

2. Frame: Manufacturer's standard.

3. Toe Guards: Equip open sides of dock leveler over range indicated with metal toe guards.

a. Toe-Guard Range: Entire upper working range.

E. Hinged Lip: Not less than 5/8-inch- thick, nonskid steel plate.

1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube and grease fittings, with gussets on lip and ramp for support.

2. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.

F. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:

a. Above Adjoining Platform: 12 inches .

b. Below Adjoining Platform: 12 inches .

2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.

3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches over width of ramp.

4. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.

a. Length of Lip Extension: 16 18 inches.

5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.

H. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches.

1. Remote-Control Station: Weatherproof single -button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.

2. Remote-Control Station with Emergency Stop: Weatherproof multibutton control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.

3. Independent Lip Operation: Electric-powered hydraulic raising and hydraulic lowering of lip, controlled independent of raising and lowering of ramp.

K. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.

1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.

2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.

N. Materials:

1. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.

2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55.

3. Steel Tubing: ASTM A 500/A 500M, cold formed.

4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

O. Dock-Leveler Finish: Manufacturer's standard finish.

1. Toe Guards: Paint toe guards to comply with ANSI Z535.1.

P. Accessories:

1. Curb Angles: 3-by-3-by-1/4-inch galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch- diameter by 6-inch- long concrete anchors welded to angle at 6 inches o.c.

3. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.

6. Abrasive skid-resistant surface.

2.3 EDGE-OF-DOCK LEVELERS

A. General: Surface-mounted, hinged-lip-type, edge-of-dock levelers designed for permanent installation on face of loading dock platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

n. Serco; 4Front Engineered Solutions, Inc. SM6630

B. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.

C. Platform Ramp Width: 66 inches.

D. Hinged Lip: Not less than 3/8-inch- thick, nonskid steel tread plate.

1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube and grease fittings, with gussets on lip and ramp for support.

E. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:

a. Above Adjoining Platform: 5 inches .

b. Below Adjoining Platform: 5 inches.

2. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.

a. Length of Lip Extension: 15 inches .

F. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with a torsion-spring counterbalancing mechanism controlled by a hold-down device.

1. Lever Handle: Self-storing lever handle for raising unloaded ramp with minimal lifting force by pulling lever back to extend lip and pushing lever forward to lower ramp and lip.

2. Removable Lifting Handle: For raising unloaded ramp by lifting action.

G. Integral Laminated-Tread Dock Bumper: Fabricated from 6-inch- thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- diameter, steel supporting rods that are welded at one end to 1/4-inch- thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch of tread plies extending beyond the face of closure angles.

H. Materials:

1. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.

2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55.

3. Steel Tubing: ASTM A 500/A 500M, cold formed.

4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

I. Dock-Leveler Finish: Manufacturer's standard finish.

2.4 FINISH REQUIREMENTS

A. Finish loading dock equipment after assembly and testing.

B. Galvanizing Hot-dip galvanize components to comply with the following:

1. ASTM A 123/A 123M for iron and steel loading dock equipment.

2. ASTM A 153/A 153M or ASTM F 2329 for iron and steel hardware for loading dock equipment.

C. Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.

C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.

B. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.

C. Clean recessed pits of debris.

3.3 INSTALLATION

A. General: Install loading dock equipment as required for a complete installation.

1. Rough-in electrical connections.

B. Recessed Dock Levelers: Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.

C. Edge -of-Dock Levelers: Attach dock levelers to loading dock platform in a manner that complies with requirements indicated for arrangement and position relative to top of platform.

1. Weld anchor holes in contact with continuous embedded loading dock edge channel. Weld or bolt bumper blocks to face of loading dock.

3.4 ADJUSTING

A. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.

B. Test dock levelers for vertical travel within operating range indicated.

C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.5 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of loading dock equipment Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION

SECTION 11 3100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Refrigeration appliances.
3. Cleaning appliances.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

C. LEED Submittals:

1. Product Data for Credit EA 1.4: For appliances indicated, documentation that products are ENERGY STAR rated.
2. Product Data for Credit EA 9.2: For water-efficient clothes washer, documentation indicating modified energy factor and water factor.

D. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

E. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Provide the following upon request:

1. Qualification Data: For manufacturer.
2. Product Certificates: For each type of appliance.
3. Field quality-control reports.

1.7 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Microwave Oven: Full warranty, including parts and labor, for on-site service on the magnetron tube.

1. Warranty Period: Five years from date of Substantial Completion.

C. Refrigerator/Freezer, Sealed System: Full warranty, including parts and labor, for on-site service on the product.

1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
2. Warranty Period for Other Components: Two years from date of Substantial Completion.

D. Dishwasher: Full warranty, including parts and labor, for on-site service on the product.

1. Warranty Period for Deterioration of Tub and Metal Door Liner: 10 years from date of Substantial Completion.
2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and 2013 CBC 11B.

2.2 MICROWAVE OVENS

A. Microwave Oven :

1. Type: Conventional.
2. Capacity: 2.0 cu. ft..
3. Oven Door: Door with observation window and pull handle.
4. Microwave Power Rating: 1000 W.
5. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A .
6. Controls: Digital panel controls and timer display.
7. Other Features: Turntable.
8. Material: Stainless steel.

2.3 REFRIGERATOR/FREEZERS

A. Refrigerator/Freezer : Two-door, side-by-side refrigerator/freezer and complying with AHAM HRF-1. Comply with 2013 CBC 11B.804.6.6.

1. Type: Freestanding.
2. Freezer Features: One freezer compartment(s) with door(s).
   a. Automatic defrost.
   b. Interior light in freezer compartment.
   c. Automatic icemaker and storage bin.
3. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

2.4 DISHWASHERS

A. Dishwasher : Complying with AHAM DW-1.

1. Type: Built-in undercounter.
2. Capacity:
   a. International Place Settings of China: 12.
   b. Water Consumption for Full Load: 3.2 gal. per cycle.
3. Sound Level: Maximum 48 dB.
4. Tub and Door Liner: Stainless steel with sealed detergent and automatic rinsing-aid dispensers.
5. Rack System: Nylon -coated sliding dish racks, with removable cutlery basket.
6. Controls: Touch-pad controls with four wash cycles and hot-air and heat-off drying cycle options.
7. Features:
   a. Waste food disposer.

b. Self-cleaning food-filter system.

c. Hot-water booster heater for 160 deg F wash water with incoming water at 100 deg F.

d. Lock-out feature.

e. Half-load option.

f. Digital display panel.

8. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Operational Test: After installation, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION

SECTION 11 5213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrically operated, front-projection screens and controls.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for metal support framing for front-projection screens.
2. Section 06 1053 "Miscellaneous Rough Carpentry" for wood backing for screen installation.

1.3 DEFINITIONS

A. Gain: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.

B. Half-Gain Angle: The angle, measured from the axis of the screen surface to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of product.

C. Shop Drawings: Show layouts and types of front-projection screens. Include the following:

1. Drop lengths.
2. Location of seams in viewing surfaces.
3. Location of screen centerline relative to ends of screen case.
4. Anchorage details, including connection to supporting structure for suspended units.
5. Details of juncture of exposed surfaces with adjacent finishes.
6. Location of wiring connections for electrically operated units.

7. Wiring diagrams for electrically operated units.
8. Accessories.

D. Samples for Initial Selection: For finishes of surface-mounted screen cases.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations: Do not deliver or install front-projection screens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 COORDINATION

A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC equipment, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.1 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS

A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Controls: Remote, key-operated, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
    a. Provide number of control switches indicated for each screen.
    b. Provide power supply for low-voltage systems if required.
3. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.

4. End-Mounted Motor: Instant-reversing, gear-drive motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Locate motor in its own compartment on right end of screen unless otherwise indicated.
5. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- diameter metal rod with ends of rod protected by plastic caps.
    a. Roller for end-mounted motor is supported by self-aligning bearings in brackets.
    b. Roller for motor in roller is supported by vibration- and noise-absorbing supports.
6. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of screen by tabs to pull screen flat horizontally. In lieu of tab tensioning, screens may be constructed from vinyl-coated screen cloth that contains horizontal stiffening monofilaments to resist edge curling.

B. Suspended, Electrically Operated Screens with Automatic Ceiling Closure, with Motor-in Roller, and with Tab Tensioning: Units designed and fabricated for suspended mounting; with bottom of case composed of two panels, fully enclosing screen, motor, and wiring; one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.
1. Provide metal or metal-lined wiring compartment.
2. Screen Case: Made from metal, wood, wood products, and fire-retardant materials.
3. Provide screen case with trim flange to receive ceiling finish.
4. Finish on Exposed Surfaces: Prime painted.

2.2 FRONT-PROJECTION SCREEN MATERIAL

A. Wide-Angle Reflective Viewing Surface: Peak gain of not less than 1.5, and half-gain angle of at least 35 degrees from the axis of the screen surface.

B. Material: Vinyl-coated, glass-fiber fabric.

C. Mildew-Resistance Rating: Zero or 1 when tested according to ASTM G 21.

D. Flame Resistance: Passes NFPA 701.

E. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.

F. Seamless Construction: Provide screens, in sizes indicated, without seams.

G. Edge Treatment: Black masking borders.

H. Provide extra drop length of dimensions and at locations indicated.
1. Color: Black.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install front-projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

1. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.

a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.

END OF SECTION

SECTION 11 5300 - LABORATORY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes furnishing and installing equipment and accessories as shown on drawings and as specified herein. The Work includes the following:

EQ #	DESCRIPTION	FURNISH BY	REMARKS
E1	Emergency Shower / Eyewash Unit	CFCI	-
E2	Snorkel	CFCI	-
E3	Procedure Light	CFCI	-
E4	Cylinder Rack	CFCI	-
E5	Biological Safety Cabinet	OFOI	For reference only
E6	Animal Transfer Station	CFCI/OFOI	-See drawings for CFCI or OFOI designation
E7	Bottle Filler	CFCI	-
E8	Bedding Dispenser	CFCI	-
E9	Bedding Dump Station	CFCI	-
E10	Isolation Cubicle	CFCI	-
E11	Grossing Station	CFCI	-
E12A	Medium Steam Sterilizer	CFCI	-Cabinet enclosed, recessed through one wall
E12B	Medium Steam Sterilizer	CFCI	Recessed through two walls
E13	Cage and Rack Washer	CFCI	-
E14	Small Steam Sterilizer	CFCI	-
E15	Double Sided Cage Rack	CFCI	160 Cages
E16	Modular Wall	CFCI	-

E17	Scullery Sink	CFCI	-
E18	Glassware Washer	CFCI	-
E19	Ice Machine	CFCI	-
E20	Gas Cylinder Cabinets	CFCI	-
E21	Tall Flammable Storage Cabinet	CFCI	-
E22	Tall Corrosive Storage Cabinet	CFCI	-
E23	Mop Rack	CFCI	Vivarium only
E24	Clothes Washer	CFCI	Shall comply with CBC11B.611
E25	Clothes Dryer	CFCI	Shall comply with CBC11B.611
E26	Safety Center w/ Emergency Shower/ Eyewash and ~~Fire Extinguisher Cabinet~~	CFCI	
E27	Undercounter Glassware Washer	OFOI	
E28	Tunnel Washer	CFCI	

B. Related Sections:

1. Division 09 Section"Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring equipment.
2. Division 11 Section" Laboratory Fume Hoods".
3. Division 12 Section 12 3553 "Fixed Laboratory Casework" for tables, cabinets, work surface tops, sinks, and service fittings.
4. Division 23 Sections for rough-ins, controls, and final connections
5. Division 23 and 26 Sections for (dis)connecting service utilities at equipment.
6. Rough openings, pits, substrate preparation, and blocking for equipment installation shall be provided as specified in other Sections

C. Drawings and Specifications outline the design intent and the general requirements of laboratory equipment. Construction details and component specifications for each product may not be complete. Equipment furnished shall be complete for the intended function and operation.

1.2 REFERENCE

A. American National Standard Institute (ANSI)

B. Underwriter's Laboratories, Inc. (UL)

C. National Electric Code (NEC)

D. American Society for Testing and Materials (ASTM)

E. National Fire Protection Association (NFPA)

F. Industrial Ventilation Manual 17th Edition, or newer

G. American Society of Heating Refrigeration, and Air Conditioning Engineers, Inc. (ASHRAE)

H. As applicable to individual equipment

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including but not limited to installation instructions and equipment options.

B. Shop Drawings: For each type of equipment indicated.

1. Indicate details for anchoring equipment to permanent building construction including locations of blocking and other supports. Include calculations demonstrating that anchorages comply with seismic performance requirements.

2. Indicate locations and types of service fittings together with associated service supply connection required.

3. Indicate duct connections, electrical connections, and locations of access panels.

4. Include roughing-in information for mechanical, plumbing, and electrical connections.

5. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from above items.

6. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples for Initial Selection: For exposed equipment finishes, when requested by University's Representative, or when a full range of colors are available from manufacturer.

D. Non-Structural Lateral Force Design: Submit detailed seismic anchorage and attachment drawings and calculations provided by a California-licenses Structural Engineer in compliance with the most current California Building Code. The submittal shall include:

1. Dimensions and location of the center of gravity of the component.

2. Weight assumed in the calculations including contents.

3. Specification of anchorage to concrete in detail, including inspection and testing requirements, if any (inspection and testing to be furnished under this section, if required).
4. Reaction loads to the supporting structure or other component.
5. If a component other than the structure is used for seismic support, the submittal shall show the adequacy of the ad path to the structure or otherwise demonstrate compliance with limitations in the contract documents.
6. The submittal will be reviewed by the design professional responsible for this section of the specification to confirm that it is response to project specific context and criteria. The adequacy of the primary structure to resist the reacton loads imparted on the primary structure by shall be reviewed and approved by the project Structural Engineer.

E. Manufacturer's Qualifications: Submit evidence that manufacturer complies with specified requirements.

F. Applicable standards approval from NEMA, NEC, UL, ETL or as specified with the individual equipment items.

G. Written certification that manufactured finish complies with specified criteria.

H. Installer qualifications per paragraph 1.3, herein.

I. Operations and Maintenance Manuals: For each type of equipment indicated. Include operating procedures, maintenance requirements (including teardown), replacement schedules, components parts lists, nearest local factory representative (including phone number and email address) for components and emergency repair. Provide a minimum of three complete manuals of each, bound and indexed.

1.4 QUALITY ASSURANCE

A. Product Designations: Drawings indicate sizes, types, and configurations of equipment by referencing designated manufacturer's catalog numbers. Other manufacturers' products of similar sizes, types, and configurations, and complying with the Specifications, may be considered. See Division 01 Section "Product Requirements" for substitution requirements.

B. Equipment may be inspected by University's Representative at the manufacturer's plant prior to shipment. Provide 14 days advance notice to University's Representative.

C. Manufacturer Qualifications: Firm having an established organization and manufacturing facilities specializing in the type of equipment specified, having an experienced engineering department and an established history of six (6) similar installations of equal scope and complexity completed in the previous three (3) years. Manufacturer shall have the demonstrated ability to produce the specified equipment of the required quality and a proven capacity to complete an installation of this size and type within the required time limits.

1. Response time for telephone inquiry: Within 4 hours.
2. Response time for site visit: 24 hours from time of telephone inquiry.

D. Installer Qualifications: An authorized representative of manufacturer.

E. Pre-installation Conference: Conduct conference at Project site.

F. For fabrication and installation of Work, use personnel who have received training and have previously fabricated or installed the specified equipment.

G. A Quality Control (QC) Plan shall be implemented for this work in accordance with the provisions in Section 014000, Quality Requirements. Work of this Section shall be conducted in compliance with all relevant provisions contained in this section and section 013300, including shop drawings, product data and samples, testing and inspection, reports, quality assurance, as-built documents and warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling, installation and during entire duration of construction project with protective covering of polyethylene film or another suitable material. Protect installed laboratory equipment from debris, paint and damage in the course of construction sequencing. Repair/replace all damaged items not acceptable to University's Representative.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period. Report to The Owner's Representative, in writing, all items that may be detrimental to equipment delivery, installation or operation.

1.7 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for lateral support of equipment.

B. Coordinate installation of equipment with laboratory casework, fume hood exhaust ducts, and plumbing and electrical work.

C. Drawings show arrangement and location of items of equipment. If it is necessary to vary from arrangement shown, because of structural, mechanical, electrical or other considerations, make such variations only after approval of The Owner's Representative and at no additional cost to The Owner.

D. Verify dimensions at building. Report to The Owner's Representative, in writing, that equipment will be able to be moved through the building in order to reach its designated location. Measure recesses and openings at building and provide trim pieces, fillers and closures in sizes required.

E. All equipment shall have integrated condensate cool-down systems prior to discharge to building drains.

1.8 WARRANTY

A. One (1) year manufacturer's warranty unless otherwise noted and identified by each specific piece of equipment.

1.9 MAINTENANCE SERVICE

A. Equipment supplier shall provide a technical response (actual presence or by phone) within 4 hours or the service call will be provided at no cost to The Owner.

B. Equipment supplier shall provide diagnostic equipment necessary for maintenance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide equipment complete with necessary supports, anchorage, stands, gages, valves, parts, and accessories required for a complete operating installation.

B. Provide each item of equipment with internal electrical services necessary for proper operation including wiring, conduit, boxes, raceways, fittings, lamps, switches, device plates, etc., sized for single point connection to building services, complying with requirements of NEC and bearing UL labeling as required.

C. Provide each item of equipment with mechanical and plumbing services necessary for proper operation including piping, fittings, ductwork, troughs, accessories, and materials, installed for easy access and connection to respective building service.

D. Provide each item of equipment fully finished by manufacturer with no additional finish or painting required after installation.

2.2 IDENTIFICATION AND RESPONSIBILITY

A. Laboratory Equipment is specified with corresponding symbols designating responsibility which have the following meanings:

1. CFCI Contractor Furnished / Contractor Installed
2. CFOI Contractor Furnished / Owner Installed
3. OFCI Owner Furnished / Contractor Installed
4. OFOI Owner Furnished / Owner installed. (Information furnished to aid in installation of utilities and other construction.)

B. Contractor Furnished/Contractor Installed (CFCI): Contractor to purchase, receive, unload, dispose of crating materials, store, unpack, re-assemble, set-in-place, install, clean-up, and protect equipment. Deliver to site in manufacturer's original labeled containers. Contractor to provide fasteners, supports or other miscellaneous items necessary for complete installation. Provide and schedule on-site equipment demonstrations at the convenience of The Owner.

Where indicated manufacturer shall provide installation supervision coordinated by the Contractor.

C. Contractor Furnished/Owner Installed (CFOI): Contractor to purchase, receive, unload, dispose of crating materials, and store equipment. Deliver to site in manufacturer's original labeled containers. Rough-ins per drawings by Contractor. Contractor to use means necessary to protect materials of this section before receipt by The Owner. Scheduling of on-site equipment delivery shall be per Contractor's schedule at the convenience of The Owner.

D. Owner Furnished/Contractor Installed (OFCI): Contractor to receive, unload, store, unpack, dispose of crating materials, set-in-place, install, clean-up, and protect equipment. The Owner will deliver to site. Contractor to provide fasteners, supports or other miscellaneous items necessary for complete installation. Rough-ins and final connections by Contractor. Contractor to inspect The Owner's equipment to determine rough-in and installation. Scheduling of on-site equipment delivery to be per Contractor's schedule at the convenience of The Owner.

E. Owner Furnished/Owner Installed (OFOI): The Owner to receive, unload, and store equipment. The Owner will deliver to site. Rough-ins by Contractor. The Owner to install and provide final connections to equipment. Contractor to use means necessary to protect materials of this section before, during and after installation and to protect installed work and materials of other trades. Scheduling of on-site equipment delivery to be per Contractor's schedule at the convenience of The Owner.

F. Refer to drawings for equipment locations.

2.3 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide one of the specified products.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before the use of an unnamed manufacturer or product.

2.4 EQUIPMENT SCHEDULE

E1 EMERGENCY SHOWER & EYEWASH

A. Manufacturers:

1. Guardian Equipment Co.
   660 North Union Street
   Chicago, IL 60610
   Phone: 312-733-2626
   www.gesafety.com

2. Water Saver Faucet Co.
   701 West Erie Street
   Chicago, IL 60610

Phone: 312-666-5500
www.wsflab.com

3. Haws Corporation
1455 Kleppe Lane
Sparks, NV 89431
Phone: 775-359-4712
www.hawsco.com

B. Product Description:

1. Emergency shower and eyewash units to meet the requirements of ANSI Standard Z358.1.
2. Barrier-Free Combination Emergency Shower and Swing Down Eye/Face Wash: Recessed wall-mounted, swing down eye/face wash with recessed stainless steel cabinet and stainless steel shower head and nipple. Units shall meet the requirements of the Americans with Disabilities Act (ADA).
3. Piping and fittings by Division 22.
4. Division 11 Contractor to supply shower/eyewash unit for installation by plumbing sub-contractor. Plumbing connections by Division 22.
5. Utility Requirements:
   a. CW 1" IPS
   b. Drain 1-1/2” for eyewash pan
   c. Alarm wiring
6. Accessories: Provide audible and flow alarm.

C. Basis of Design: Guardian GBF2150. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E2 SNORKEL

A. Manufacturers:

1. Movex Inc.
104 Commerce Drive, Northampton, PA 18067
Phone: 610-440-0478
www.movexinc.com
2. Nederman LLC
102 Transit Avenue, Thomasville, NC 27360
Phone: 855-598-3171
www.nederman.com
3. Enviroflex International Inc.
1051 Clinton Street, Unit 217, Buffalo, NY 14206
Phone: 716-883-2319
www.enviroflex.com

B. Product Description:

1. Ceiling mounted 3” diameter scavenger arm (extraction arm, fume extractor, snorkel) shall be fabricated of white polypropylene or PVC articulated joints and hood, anodized aluminum arms and stainless steel threaded stays and springs.
2. Accessories:
   a. Wall Bracket where wall mounted indicated, exhaust ducting from wall bracket to ceiling connection.
   b. Aluminum Hood (10" dia. cone).
3. Installation: Verify adequate support framing has been installed above ceiling for ceiling mounted installations. Provide hood mounting bracket to facilitate easy removal and replacement of multiple hoods.
4. Services:
   a. Exhaust: 3" dia., 75-100 CFM
5. Ratings: UL rating on fan.

C. Basis of Design: Movex ME 75. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E3 PROCEDURE LIGHT

A. Manufacturers:

1. Berchtold Corporation
   1950 Hanahan Road, Charleston, SC 29406
   Phone: 800-243-5135
   www.berchtoldusa.com
2. Philips Burton Medical Products
   11500 Melrose Avenue, Franklin Park, IL 60131
   Phone: 800-444-9909
   www.burtonmedical.com
3. Skytron
   5085 Corporate Exchange Blvd. SE, Grand Rapids, MI 49512
   Phone: 800-759-8766
   www.skytron.us

B. Product Description:

1. Lighting system shall consist of a 13” beam diameter LED exam light. Includes polymer lighthead with a minimum of 3 high efficiency LED modules and a minimum life of 20,000 hours. Wall mounted with a total reach of 63”. 360° rotation of arms. Total system output is to be a minimum of 45,000 lux at a color temperature of 4,300°K.
2. CRI: 92; Color Temperature 4300K
3. Light to be of light weight polymer construction.
4. Provide sterilizable positioning handle.

5. Utility Requirements:
   a. Elec. 120V/60 Hz

C. Basis of Design: Berchtold Chromophare F 300 wall mount. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E4 GAS CYLINDER RACK

A. Manufacturers:

1. Safe-T-Rack™ Systems, Inc.
   4325 Dominguez Road, Suite A
   Rocklin, CA 95677
   Phone: 800-344-0619
   www.safe-t-racksystems.com

2. JT Racking Systems
   41551 Date Street
   Murrieta, CA 92562
   Phone: 888-921-9351
   www.certifiedmedicalsales.com/gas-cylinder-storage-racks.shtml

3. Matheson
   166 Keystone Dr, Montgomeryville, PA 18936
   Phone: 800-416-2505
   www.mathesongas.com

B. Product Description:

1. Product Description: Welded 2" x 2" x 1/8" tube steel construction with 5/16" steel welded link chain, electrically zinc plated. Model numbers to match configurations in the Contract Documents. Finish shall be factory applied exterior grade baked on polyurethane paint in manufacturer's standard gloss black.

C. Basis of Design: Safe-T-Rack Model Series 2400 with dual restraint. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E5 BIOSAFETY CABINET CLASS II/A2 CANOPY EXHAUST CONNECTION (OFOI- For Reference Only)

A. Manufacturers:

1. Thermo Fisher Scientific Inc.
   Phone: 800-556-2323
   www.thermoscientific.com

2. Baker

POB Drawer E,
Sanford, MA 04073
Phone: 800-992-2537
www.bakerco.com

3. Nuaire
2100 Fernbrook Lane,
Plymouth, MN 55447
Phone: 800-328-3352
www.nuaire.com

B. Product Description:

1. Provide a certified copy of the Personnel, Product and Cross-contamination (Biological) tests, equivalent to or more severe than as specified in NSF Standard #49, Performed on one unit from each production run from which cabinets have been manufactured. All units must meet NSF #49 performance requirements and have NSF #49 label attached.

2. Cabinet will have zoned or uniform down flow velocity profile relative to down flow velocity over the work surface. All biologically contaminated ducts and plenums maintained under negative pressure or enclosed within a negative pressure zone.

3. Sliding view screen of ¼"tempered glass capable of moving to a fully closed or open (20") position during shut down periods. Audible alarm to indicate when view screen is in unsafe position. Calculated intake velocity through front 10" access opening (in DCM area) and 8" access opening (in upper lab floors) maintained between 100-110 fpm.

4. Both exhaust and supply filters to be front loading and meet the zero-probed HEPA 99.99% efficient on all particles 0.3 micron by DOP test. Minihelic pressure gage (up to 2" W.G.) to monitor filter loading.

5. Cabinet constructed of #18 gage cold-rolled steel, with #16 gage stainless steel work surface and radius (rounded) corners on the work surface. Side walls and rear wall one-piece or welded construction. Stainless steel air diffuser and filter protector provided in work area. Stainless steel fixed or adjustable leg assembly will provide a work surface height of 30". Units must pass through an 84" high door opening.

6. Work area provided with two (2) externally mounted GFI duplex 120V outlets with drip-proof covers and circuit breakers. Provide one (1) vacuum (VAC) fixture. Provide fluorescent light (100 foot-candles of illumination at work surface). Provide UV light.

7. Unit capable of automatically handling a 60% minimum increase in filter loading without a decrease in total air delivery of more than 10%. Provide a voltage compensating motor speed controller that automatically compensates for voltage changes to maintain constant voltage to motor. Speed controller will permit manual adjustment to handle a 150% increase in filter loading and maintain total air delivery at or above 90%.

8. Provide low flow sensing device whose probe will be mounted in 12" high duct section to monitor total exhaust capacity. This device shall include the following factory wired and assembled components:

a. One monitor which includes LED indicator lights, (green: normal airflow; yellow: caution; red: low flow), electronic analog meter (with green, yellow and red zones) and audible alarm. In addition there shall be a switch to silence the audible alarm and a separate indication that the audible alarm has been silenced.
b. One (1) airflow sensor probe
c. One (1) Transformer: 120VAC input
d. Appropriate mounting brackets and hardware to install the monitor and probe to the bio safety cabinet.
e. The probe shall be factory calibrated to the monitor thereby eliminating field calibration.
f. The monitor shall have a factory reset operating range of 500-2000 feet per minute (FPM)
g. The unit shall have a night setback capability
h. The monitor shall have a relay output.

9. Unit shall be capable of operating at 10-30C
10. Unit completely factory pre-wired with 12' power cord. Supply a 0.1 Amp form "C" contact on the blower switch to interact with a potential room control package. Complete units, including flow alarm, listed as certified by IL or ETL, for electrical safety and integrity.
11. Provide pressure differential switch to automatically shut off supply blower in event of exhaust failure and a self-contained filter changing isolation system, including a disposable bag.
12. Provide manual adjustable stand.
13. Provide thimble duct exhaust transition for units as shown on drawings.
14. Unit to carry a three (3) year warranty.
15. Provide seismic anchorage.
16. Utility requirements:
    a. Elec.: 1/60/120V
    b. VAC: 3/8" NPT
    c. EXH: 10" dia.

C. Basis of Design: Thermo Fisher – Model 1300 Series A2 6' nominal length Class II, Type A2 Biological Safety Cabinet with 10" sash opening and thimble exhaust connection for units ash shown on drawings. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E6 ANIMAL TRANSFER STATION – CFCI/OFOI

A. Manufacturers:

1. Nuaire

2100 Fernbrook Lane, Plymouth, MN 55447
Phone: 800-328-3352
www.nuaire.com

2. Baker
POB Drawer E, Sanford, MA 04073
Phone: (800) 992-2537
www.bakerco.com

3. Allentown, Inc.
165 County Rd 526. Allentown, NJ 08501
Phone: 609-259-7951
www.allentowninc.com

B. Product Description:

1. Mobile animal transfer station providing high efficiency particulate air (HEPA) in a downward laminar airflow direction to an adjustable height work surface. Overall nominal unit dimensions 48" wide x 30" deep x 80-88"high. Work surface height adjustable from 33"-41" AFF. Include adjustable electric auto-lift system.

2. Unit construction 16 ga. Cold rolled tubular frame and cold rolled steel panel construction (Type 304, 16 ga. Stainless steel work surface). Supply plenum shall be supported by two slender tubes located at midpoint of 30" sides. No sash or enclosure between work surface and supply plenum. Stainless steel stem casters with 6" diameter phenolic wheels, brakes on all four casters and stainless steel Zerk fittings in axle and raceway.

3. Installation: Free-standing portable unit.

4. Unit to carry a three (3) year warranty.

5. See Drawings for CFCI vs. OFOI equipment locations.

6. Utility requirements:

a. Electrical: 1/60/115V

C. Basis of Design: 4' Nuaire AllerGard NU-619 Animal Transfer Station. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E7 BOTTLE FILLER

A. Manufacturers:

1. LYNX Product Group
650 Lake Street, Wilson, NY 14172
Phone: 716-751-3100
www.lynxpg.com

2. TBJ
1671 Orchard Drive,
Chambersburg, PA 17201
(717) 261-1730
www.tbjinc.com

3. Edstrom Industries,
   819 Bakke Ave.
   Waterford, WI 53185
   Phone: 262-534-5181
   www.edstrom.com

B. Product Description:

1. Application: Manual, conveyorized feeder bottle filling system utilizing manifold type fillers and transport baskets.
2. Size: 24”W x 48”H x 44”L
3. Basket: Vendor to confirm with Owner appropriate basket size and configuration without change in contract cost.
4. Bottles: 8 oz or 16 oz capacity.
5. Operation: Operator places empty racks of clean bottles on the conveyor. Bottles are positioned beneath the filler manifold and operator manually opens the fill valve. Water is dispensed through a pattern of individual nozzles located in the manifold suspended above the bottles, filling all bottles simultaneously.
6. Construction:
   a. Manual or auto fill operation: Standard units are provided with a manually operated ball valve to control filling of the racked bottles. Unit is provided with manual and auto-fill button with indicator light.
   b. Filler manifold height is adjustable to accommodate varying height bottle racks with identical filling patterns. Individually machined, brass-filling jets are provided in the filling header to fill each bottle.
   c. Splash hood, drain pan and legs are constructed of 14 gage type 314 stainless steel with no. 3 finish. Drain pan and legs are integrally welded with watertight welds for the drain pan. Legs are equipped with adjustable feet.
   d. Filler piping, ball valves and solenoid valve are type 304 stainless steel.
7. Accessories: Bottle basket transfer cart; (4) Bottle baskets
8. Options: Automatic operations; Stainless steel piping and components; Acid proportioner
9. Utility Requirements:
   a. RGW 1” NPT, 35 PIS +/- 5 PSI
   b. Drain 1-1/2” Connection.
   c. Elec: 120 VAC
10. Unit(s) to carry a one (1) year parts and labor warranty.

C. Basis of Design: LYNX 100LX Bottle Filler. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E8 BEDDING DISPENSER

A. Manufacturers:

1. LYNX Product Group
650 Lake Street, Wilson, NY 14172
Phone: 716-751-3100
www.lynxpg.com

2. SMC Schlyer
814 Wurlitzer Drive
North Tonawanda, NY 14120
Phone: 866-867-7660
www.smc-roe.com

3. TBJ
1671 Orchard Drive,
Chambersburg, PA 17201
(717) 261-1730
www.tbjinc.com

B. Product Description:

1. Unit shall have an integral dust collection system.

2. Stainless steel construction: Break apart design for maintenance.

3. Hopper Capacity: The bedding storage capacity is 12cu.ft.

4. Operator Control Panel: Stainless steel panel containing On/Off switches for bedding transfer is provided on the front of the unit. Operational indicating lights and a conveyor dispensing filling rate switch are provided.

5. Hopper Loading: Storage hopper located on the side of the unit is filled by dumping the bedding from the bag into the stainless steel hopper. The storage hopper is equipped with a stainless steel lid and safety gate if the gate is removed during the operation of the unit, the cycle will cease in operations until it is replaced protecting the operator from the moving dispensing mechanism.

6. Unit shall include (1) year warranty for parts and labor.

7. Provide the following:
   a. Dust Collection System
   b. Knocked Down Shipment
   c. Seismic Restraints

8. Utilities:
   a. Elec: 120V, 1PH, 60 Hz 30.0A
   b. Air: ½" NPT, 90 psi, 4 CFM Intermittent Usage

C. Basis of Design: LYNX Model 740LXv. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E9 BEDDING DUMP STATION

A. Manufacturers:

1. Nuaire
2100 Fernbrook Lane, Plymouth, MN 55447
Phone: 800-328-3352
www.nuaire.com

2. Baker
POB Drawer E, Sanford, MA 04073
Phone: (800) 992-2537
www.bakerco.com

3. Allentown, Inc.
165 County Rd 526. Allentown, NJ 08501
Phone: 609-259-7951
www.allentowninc.com

B. Product Description:

1. HEPA filtered waste animal bedding disposal unit with 100 FPM air barrier. 16" access opening. Stainless steel work surface, castered base cabinet, front filter removal, pre-filter, hinged viewing window, fluorescent light.

2. Utility requirements:

a. Elec.: 1/60/115V

C. Basis of Design: Nuaire Allergard NU-607 Animal Bedding Disposal Containment Unit. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E10 ISOLATION CUBICLE

A. Manufacturers:

1. Britz & Company
1302 9th St.
Wheatland, WY 82201
(800)-808-5609
www.britzco.com

2. LGL Animal Care Products, Inc.
721 Peach Creek Cut-Off Rd.
College Station, TX 77845
Phone: (979) 690-3434
www.lglacp.com

3. Lab Products, Inc.,
742 Sussex Avenue, PO Box 639,
Seaford, DE 19973
Phone: (800) 526-0469
www.labproductsinc.com

B. Description: The door rolls vertically and stores overhead, which maximizes the cubicle entry way. The unit also includes a motor and drive assembly and an electronic controller that provides for smooth door operation. The door is controlled via a touch screen. The system requires a 120VAC/15Amp/60HzCircuit for electrical requirements. Units may be attached to facility CMU walls or to Britz & Company sound dampening SIP walls. This unit does include integration with the building BAS system via the PLC. This is a basic feature of the PLC as a single discrete (digital) 24 volt DC contact that will active under any alarmed condition.

C. Basis of Design: Britz & Company Rollup Cubicle. Dimensions 84”x 48”x 111” and 84”x 42”x 111” as noted in contract documents. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E11 GROSSING STATION

A. Manufacturers:

1. TBJ
   1671 Orchard Drive,
   Chambersburg, PA 17201
   (717) 261-1730
   www.tbjinc.com

2. Scientek
   7943A Progress Way
   Delta, BC Canada V4G 1A3
   (604) 940-8084
   www.scientek.com

3. Mopec
   21750 Coolidge Highway,
   Oak Park, MI 48237
   Phone: 800-362-8491
   www.mopec.com

4. Mortech Manufacturing
   45 La Porte Street
   Arcadia, CA 91006
   (800) 410-0100
   www.mortechmfg.com

B. Product Description:

1. Backdraft table designed to provide a ventilated workstation for animal necropsies, surgeries, perfusions, and dissections. The table shall function to pull air, odors, vapors, and aerosols back and away from the face of personnel when connected to a negative air source.

2. Overall table dimensions shall be 48” wide x 28” deep. The work surface height shall be adjustable in height from 32” to 44” high

3. The table shall utilize Type 316 stainless steel construction for all welded-wetted sink and drain pan components. All welds shall be heliarc. All exposed welds shall be ground to a seamless polished finish.
4. The table shall utilize 18 gage T316 stainless steel, removable, perforated work surface panels. The panels shall be recessed 1/2" below the table perimeter to prevent fluids form escaping the work area.
5. The table shall utilize a stainless steel backdraft plenum that includes a removable perforated exhaust panel constructed of 18 gage T 316 stainless steel with a #4 finish to create a uniform backdraft air velocity across the entire work surface.
6. An 8" round exhaust connection shall be located on the top of the table with a neoprene exhaust bellows connection for the elevating height option.
7. The table shall utilize a control valve, vacuum breaker, and (2) flush down manifolds which horizontally run the length of each side of the table, below the work surface to rinse away fluids and debris.
8. The table shall include a hand spray gun assembly with a recoil hose for table cleanup.
9. The table shall be factory pre-plumbed and pre-wired ready for single-point connection of utilities on site.
10. Accessories:
    a. Ground-fault circuit interrupter (GFCI) receptacle
    b. Hand spray assembly
    c. Swing gooseneck, in-line vacuum breaker, and wrist blades
    d. Halogen task lamp with magnifier
    e. ANSI approved deck mounted eye wash
    f. Flexible neoprene exhaust bellows for elevating height option
11. Utility Requirements:
    a. Electrical: 115V, 60 Hz, 1 phase, 20A
    b. Hot Water: 1/2" N.P.S.
    c. Cold Water: 3/4" N.P.S.
    d. Drain: 1-1/2" N.P.S.
    e. Exhaust: 8" (O.D.)

C. Basis of Design: TBJ Grossing Table, model 28-48 BD. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E12 MEDIUM STEAM STERILIZER – DOUBLE DOOR PASS-THRU

A. Manufacturers:

1. Consolidated Sterilizer Systems
   76 Ashford Street,
   Boston, MA 02134-0003
   Phone: 617-782-6072

www.consteril.com

2. Steris Corporation
   5960 Heisley Road,
   Mentor, OH 44060
   Phone: 800-444-9009
   www.sterislifesciences.com

3. PRIMUS Sterilizer Company, LLC.
   6565 South 118th Street,
   Omaha, NE 68137
   Phone: 402-344-4200
   www.primus-sterilizer.com

4. Getinge USA
   1777 E. Henrietta Road,
   Rochester, NY 14623
   Phone: 800-475-9040
   www.getingeusa.com

5. ETC Sterilization Systems
   125 James Way,
   Southampton, PA 18966
   Phone: 215-355-9100
   www.etcsterilization.com

6. Steelco USA
   990 Stinson Way, Unit 307,
   West Palm Beach, FL 33411
   Phone: 561-791-8313
   www.steelcospa.com

B. Product Description

1. 24” x 36” x 60” cabinet enclosed pre-vacuum unit with Liquid Cycle unit with double radial arm doors, 316L stainless steel chamber. Controller shall provide option to pass contents through after sterilization cycle or contents can be removed from non-sterile side after sterilization cycle.

2. Unit shall carry a three (3) year warranty and vessel to carry a fifteen (15) year warranty.

3. Utility Requirements:
   a. Elec. for controls: 120 volt, 50/60 Hz, 1-phase, 2 amp.
   b. Elec. For Vacuum Pump: 208/480 volt, 60 Hz, 3 phase, 6/3 amps.
   c. Sterilizer feed water: 1” NPT, 20 - 50 psig dynamic (CW must meet manufacturer’s requirement for hardness). Consumption = 130 gal/hr., Peak Flow
   d. Sterilizer Drain: 2” connection.
   e. Steam (provided by steam generator): 3/4” NPT, 50 – 80 psig, 185 lb/hr., Peak Flow = 335 lb/hr.

4. E12A unit shall be cabinet enclosed, recessed through one wall.

5. E12B unit shall be recessed through one modular stainless steel wall and one architectural wall.
6. Accessories:
   a. Chamber rack and shelf,
   b. Loading car with two shelves.
   c. Transfer carriage
   d. Air differential seal on sterile side.
   e. Provide water conservation vacuum system.
   f. Drain discharge cooldown modified for use with recycled city water.
   g. Provide Seismic tie-down kit.
7. Steam Generator: Include one (1) 210 KW horizontal electric steam generator to provide steam for both medium sterilizers.
   a. Steam Generator Utility Requirements:
      1) Electrical: 100V/ 1 Ph
      2) Power Supply: 210 KW/480V/3Ph/253 Amps
      3) Feedwater: 1" NPT, 45 psi dynamic minimum 5 GPM Peak
      4) Drain: Open drain to funnel connection in floor, diameter 3" minimum, 2½" air gap.

C. Basis of Design: Consolidated Model # SR-24E Medium Lab Series Steam Sterilizer 24" x 36" x 60" prevacuum steam sterilizer. Double door pass-thru. One unit recessed through architectural wall and modular stainless steel wall. One unit cabinet enclosed, recessed through architectural wall on sterile end. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E13 CAGE AND RACK WASHER

A. Manufacturers

1. LYNX Product Group
   18 Mill Street, Middleport, NY 14105
   Phone: 716-735-9857
   www.lynxpg.com
2. Steris Corporation
   5960 Heisley Road, Mentor, OH 44060
   Phone: 800-444-9009
   www.sterislifesciences.com
3. Steelco USA
   990 Stinson Way, Unit 307, West Palm Beach, FL 33411
   Phone: 561-791-8313
   www.steelcospa.com

4. Tecniplast USA
   PO Box 1457, Exton, PA 19341
   Phone: 877-669-2243
   www.tecniplastusa.com

B. Product Description:

1. Application: Heavy duty, large capacity hydrospray batch-type washer designed for thorough, efficient cleaning of cages, racks, debris pans and miscellaneous items used in care of laboratory animals.
   a. Minimum Compartment: 46”W x 85”H x 92”L.
   b. Maximum External Size: 86”W x 104”H x 100”L.
   c. Maximum Pit: 78”W x 12”D x 101”L.
   d. Chamber inside bottom shall align with finished floor. Coordinate final pit dimensions, miscellaneous metal requirements and floor drain location.

2. Operation
   a. Operator places items to be cleaned within compartment, closes door and presses automatic cycle push button. Machine proceeds through treatment schedule and automatically shuts off at completion of the cycle. Operator then opens door and removes cleaned item. “Reusable-Throwaway” Alkaline and Acid Solution System: Provide capability to automatically return alkaline and/or acid solution to their respective reservoirs or pump to drain.
   b. Treatment Schedule: A multiple cycle treatment schedule automatically programmed into washer as follows(additional wash, soak and rinse cycles can be added):
      1) Pre-Wash: Water remaining in recirculating sump from final rinse of previous cycle or fresh hot water is recirculated through jet system under pump pressure then pumped to drain upon completion. Phase time is programmable from 0-60 minutes.
      2) Alkaline Wash: Hot alkaline from alkaline reservoir fills sump and is pumped through jet system. At end of treatment, alkaline solution is either returned to alkaline reservoir tank or pumped to drain at discretion of operator. Phase time and temperature are programmable from 0-60 minutes and to 190ºF.
      3) Acid Wash: Hot acid solution fills recirculating sump and is pumped through jet system. At end of treatment, water is pumped to drain upon completion.
      4) Phase time and temperature are programmable from 0-60 minutes and to 190ºF.
      5) First Rinse: Hot water from house supply fills recirculating sump and is pumped through jet system. At end of treatments, water is pumped to drain upon completion. Phase time and temperature are programmable from 0-60 minutes and to 190ºF.

6) Final Rinse: Same as first rinse except at end of treatment, water is retained in recirculating sump to be used as pre-wash water for subsequent load. Phase time and temperature are programmable from 0-60 minutes and to 190ºF.

c. Exhaust: Unit stands idle for a sufficient length of time to remove residual vapor from air with compartment. Phase time is programmable from 0-6 minutes.

3. Construction:

a. Base, washing chamber, detergent tank and recirculating sump of welded stainless steel construction. Washing chamber sections flanged and bolted using formed channels across joints. Base shall contain integral door gutters, recirculating sump and floor grating supports.

b. Each door of double wall construction, insulated with 2" thick rigid fiberglass insulation, and equipped with a double bulb sealing gasket, safety exit hardware, heavy duty stainless steel hinges, and a minimum 12"x12" tempered glass observation window.

c. Compartment floor shall consist of heavy-duty stainless steel grating sections covering the entire floor area and pitched 1" at unload end to accommodate poor draining cages, pans and racks. Grating sections easily removable without tools.

d. Recirculating sump equipped with an automatic solution level control, automatic rinse water fill, and stainless steel steam coil heating for recirculating treatment solutions. An automatic digital temperature controller mounted in operator's panel shall display and monitor recirculating solution temperature. Recirculating sump shall have no openings beyond base of machine to emit vapor from recirculating solutions.

e. Detergent reservoir minimum 250-gallon capacity, heated by stainless steel stem coils. Reservoir equipped with an automatic digital temperature controller, automatic water fill, automatic water level control, automatic drain valve, and overflow piping.

f. All treatments under pressure from one (1) 10 HP full draining type pumps, with no cross-contamination. Pumps are not acceptable if they employ extended shaft motors. The pump system shall be equipped with a direct reading pressure gage.

g. A stainless steel steam coil heating for recirculating sump complete with condensate return and steam traps. A by-pass system inter-piped into machine to remove suspended water droplets and minute particles of debris from incoming steam line and automatically flush to condensate return. Surface area of steam coils a minimum of 30 square feet for detergent tank and 60 square feet for recirculating sump. Steam coils designed to ASME Section VIII, Div 1, and Unfired Pressurized Vessel Code and be easily removable for cleaning or maintenance. Coils shall not be welded in place.

h. Each treatment pump equipped with a stainless steel automatic self cleaning screen, minimum 3-1/2" diameter x 18" long manufactured from perforated stainless steel. Screen shall have 1/16" diameter perforations and be interpiped and inter-wired with motor operated ball valves to collect debris during treatment portion of each cycle and direct debris to sewer when draining any treatment solution. Floor screens that accumulate debris from load to load will not be allowed.

i. Oscillating Jet System shall consist of the following:
   1) Eight (8) spray trees suspended from an oscillating carriage. A total of 80 machined jets each capable of 4 GPM @ 20 PSI mounted in the spray trees. Each spray tree shall be equipped with an additional jet spraying outward to rinse the inside cabinet walls.
   2) Oscillating system driven by a minimum 1/3 HP motor through a gear reducer. A reversible motor dive system is not acceptable. Driving the oscillating carriage by a rod less air cylinder is acceptable as well.
   3) Oil tight micro switches provided to guarantee oscillating reader system covers the entire length of the chamber.
   4) Temperature guarantees (defeated through microprocessor with password):
   5) 180ºF final Rinse. Final rinse timer will not start timing until recirculating water temperature has reached at least 180ºF thus assuring entire final rinse time 180ºF minimum. Recirculating temperature to reach 180ºF within 2-3 minutes after final rinse begins recirculation.
   6) 180ºF Wash Solution. Wash timer will not start timing until recirculating wash solution temperature has reached at least 180ºF, thus assuring entire wash time at 180ºF minimum. Recirculating temperature to reach 180ºF within 2-3 minutes after wash solution begins recirculation.
   7) Within control box is transformer for 1/60/115V control circuit, magnetic starters with overload protection for all motors and all other electrical components required for machine operation.

j. Safety features:
   1) Each door fitted with a magnetic reed switch, which will stop all machine operation, if door is opened during cycle. To resume operation door must be closed and start button must again be pressed.
   2) A stainless steel safety cable installed on both side inside the wash compartment approximately 3'-0" above floor and runs entire length. Cable is to be red in color. If cable is pulled, machine shall immediately cease all operations. To resume operation, power must first be turned off, then turned on again and start button depressed.
   3) Each door equipped with spring loaded, explosion relief typed latches that open readily when pushed from inside cabinet. Latches that lock and/or require additional hardware inside cabinet to open are not acceptable.
   4) Emergency stop buttons provided on load and unload end control panels. Circuitry connected to a normally-open relay for added system reliability.

k. Automatically actuated motor ball valves to control output of pump to jet system, drain, or detergent return system.

l. Inter-piped and inter-wired so that only one connection required for each service or utility.

m. Three (3) detergent injection ports and dry electrical contacts for installation of automatic detergent injection. Washer sump equipped with two (2) 1" NPT fittings/couplings for connection of external devices.

n. Water line to be protected from hammering by using slow closing valves.

o. Place all serviceable components on either right or left-hand side of washer as indicated on the Equipment Drawings.

p. Additional door for pass-through operation complete with safety switch and lights indicating washer is in operation or cycle is complete. Door shall meet all requirements stated above.

q. Top and sides insulated with minimum 2" thick rigid fiberglass covered by a protective stainless steel jacket.

r. Solid-state microcomputer control system that monitors and automatically controls all process operations and functions. Provide primary and secondary microprocessor control panels on load and unload ends, respectively. Cycle phase times, temperatures and other key process parameters are programmable and may be locked in by supervision. A 12 cycle menu of treatment processes may be programmed and retained to permit operating personnel to accommodate a wide variety of load and processing requirements. Cycle programming controlled by access code to insure process integrity. Each cycle program may be reviewed and printed on demand. Highly visible color touch panel screen shall display cycle program data on demand and real time in process cycle performance. Programming may be in standard AM/PM or military time, temperature in Fahrenheit or Centigrade. Times and temperatures expressed in minutes/seconds and tenths of degree increments respectively. An internal battery shall back up all cycle memory for up to one (1) year and permit completion of a cycle upon restoration of power after a power disruption. All cycle deviations are alarmed visually and audibly, recorded and must be acknowledged by operator. A built-in service diagnostic program, accessible by service access code, provided and displayed to permit system calibration and verification of satisfactory component operation. Provide a strip chart printer with paper take up and clear waterproof cover to record all cycle program and in process performance data. Provide an RS232 port to down load cycle data to a remote computer. All data from control system to communications port in ASCII format compatible with PC/DOS support software. Machine equipped with 0.1 amp Form C dry contacts to communicate with building DDC system and send a signal when the unit is turned on or off and a door is opened or closed.

s. Ship disassembled into sections that will pass through a 3'-6" x 6'-8" doorway.

t. Stainless steel barrier flanges on load and unload end and insulated stainless steel modular walls between CRW and ITW from floor to ceiling to enclose utilities.

u. Automatic motorized damper mounted in exhaust line and inter-wired with automatic cycle. Damper open during exhaust cycle and closed during machine operation.

v. External vapor proof light that shall illuminate the wash compartment.

w. Separate acid detergent treatment after alkaline wash. Treatment pump and all components and piping that come in contact with acid solutions furnished in stainless steel.

x. Cool-down system to reduce all sump drain discharges to 140ºF, or less, controlled by microprocessor. Water conservation system will utilize building 45ºF chilled water system for sump and vapor condenser.

y. Time-based, volumetric neutralization of sump controlled by microprocessor. If neutralizing agents are spent, an alarm will sound and machine will stop until neutralizing agents are replenished or system is manually overridden.

z. Instantaneous steam to water heat exchanger is raising hot water supply temperature at least 60-80ºF.

aa. Stationary spray header mounted in floor of unit to ensure complete exposure of underside of load to treatment schedule.

bb. Stainless steel entry/exit pit transition plates to bridge space between unit and pit. Chamber bottom shall align with finished floor +/-1/32".

cc. Minimum 70% efficient to pre-exhaust vapor condenser with coil using building chilled water at 45ºF.

dd. Rack manifold flush system capable of flushing two (2) automatic water racks with house automatic-watering (AW) water during the final rinse cycle. Provide two (2) quick disconnect hoses in wash compartment. System shall be inter-piped and inter-wired for automatic operation.

ee. Provide the following options:

1) Feeder bottle washing system.
2) Pan washing.
3) LYNX OPT-Wash System

ff. Provide the following accessories:

1) One (1) total, stainless steel feeder bottle-washing cart with a quick disconnect fitting designed to process six (6) baskets of bottles per load each. Coordinate basket size and configuration with Owner.
2) Four (4) total, heavy duty, stainless steel cage wash carts designed to hold rodent cages from 5"-8" in height, on four rows per side of cart. Cart shall accommodate up to 72 standard mouse cages or 48 standard rat boxes. Cart shall feature automatic swivel-type retainers to secure cages rigidly in place during cleaning and four swivel casters constructed of stainless steel with neoprene wheels. Cart shall be nominally 72"L x 82"H x 32"W.
3) Seismic tie-down kit.
4) Barrier wall flange assembly.
5) Drain discharge cool down with cold water

gg. Materials (all stainless steel, S.S., type 304):

Item		Material
1)	Base & Recirculating Sump	12 gage S.S. #2B Finish.
2)	Door Frames	2"x2"x3/16" S.S. Angle.
3)	Door Panels	16 gage S.S. #3 Finish.
4)	Side and Top Panels	14 gage S.S. #3 Finish.
5)	Recirculating Pump Piping	S.S.
6)	Internal Water & Steam Piping	S.S.
7)	External Steam Piping	Schedule 80 Black Iron.

8)	Steam Condensate	Schedule 80 Black Iron.
9)	External Water Piping	Brass
10)	Spray Jets	S.S.
11)	Grating	S.S.
12)	Steam Coils	S.S.
13)	Barrier Flange & Modular Wall	20 gage S.S. #3 Finish.
14)	Insulated Jacket	20 gage S.S. #3 Finish.

4. Utility Requirements:
   a. E 480V (18A).
   b. ST 2”NPT (1200#/hr @ 30-80 psig with a maximum of 80 psig)
   c. HW 1½” NPT (50 gpm, @ 140ºF, 35 psi).
   d. COND 1”NPT. Maximum lift 15’
   e. D 4”FD min, 120 gpm flow rate
   f. EXH 12” ID 450cfm
   g. CW 1½” NPT (60 gpm @ 50°F ±5°F, 35 psi).
   h. A ½”NPT, 100 PSI, 6 CFM Flow Rate
   i. SPCL Dry contacts for DDC

C. Basis of Design: Unit shall be LYNX Model 410LX Cage and Rack Washer, configuration as shown in drawings. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E14 SMALL STEAM STERILIZER

A. Manufacturer

1. Consolidated Sterilizers,
   76 Ashford Street,
   Boston, MA 02134
   Phone: 617-782-6072
   www.consteril.com
2. Steris Corporation
   5960 Heisley Road,
   Mentor, OH 44060
   Phone: 800-444-9009
   www.sterislifesciences.com
3. Getinge USA
   1777 E. Henrietta Road,
   Rochester, NY 14623
   Phone: 800-475-9040
   www.getingeusa.com
4. BetaStar
   584 Poplar Road,
   Honey Brook, PA 19344

Phone: 610-273-2457
www.betastar.com

B. Product Description

1. Product Description: Gravity/Vacuum Steam Sterilizer, single door
2. Chamber Size: 20" x 20" x 38" – Minor size variation based on Manufacturer's standard size chamber is acceptable.
3. Features and Options: Integral vacuum pump.
4. Units shall have Water Eco Basic option.
5. Vivarium Sterilizer shall be provided with the following design features:
   a. Control lockout to prevent cycle start up if door not sealed
   b. Printer to document alarms and cycle data
   c. Alarms – audible and documented acknowledgement
   d. Water Conservation System
   e. Programmable for automatic start up and shut down
   f. Non-proprietary PLC control system
   g. Solenoid control valves
   h. Vacuum level and pull-down to approximately 27" @ sea level within 5 minutes with empty chamber
   i. Manufacturer's standard finish on chamber interiors
   j. 316L stainless steel chamber and 304 stainless steel jacket
   k. Non-proprietary valves and components. All valves and components in contact with steam shall be of brass/bronze.
   l. Factory trained service technicians – local service available
   m. Provide service training for owner for operating equipment
6. Accessories: Rack with two shelves
7. Because each sterilizer manufacturer provides different options regarding utility needs and water conservation issues, bid information is to provide the following:
   a. Identify all utility requirements different from what is provided for in the construction documents.
   b. Description of manufacturer's standard water conservation features (if any) in base bid. Manufacturer to also provide a description of additional proposed option(s) with additional costs identified for manufacturer specific water conservation features available (such as a re-circulating water conservation vacuum system) as well as design implications for each water conservation option (for example: additional square footage needed or additional utility needs).
8. Unit shall carry a one (1) year warranty and preventative maintenance. Vessel to carry a fifteen (15) year warranty.
9. Service Connections: Building is to provide the following services for the sterilizer. Manufacturer shall verify requirements for unit and coordinate with general contractor for any required service revisions at no additional cost to the owner.

a. Wastewater cooling ½" NPT, 45 psig dynamic, 80 psig static max, 12 gpm
b. Elec. 1/60/110V, 20 amp min for controls
c. Ethernet RD-45
d. CW 1" NPT, 30-50 psig dynamic, (CW must meet manufacturers requirement for hardness)
e. Drain 1-1/2" ODT.
f. Steam ½" NPT, 50-80 psig, 180 lbs/hr capacity
g. Elec. 480V/3Ph/20 amp min for vacuum pump
h. Vacuum pump water ½" NPT, 45 psig dynamic, 80 psig static max, 12 gpm

10. Unit must fit through 42" door opening for installation.
11. Provide the following accessories:
    a. Seismic tie-down kit.
    b. Drain discharge cool down feature modified for use with recycled city water.
    c. Loading rack and two shelves.
12. Provide steam-to steam generator to deliver clean steam to the chamber.

C. Basis of Design: Consolidated Model SSR-3AV Small Lab Series Steam Sterilizer 20" x 20" x 38" Gravity/vacuum steam sterilizer unit with single door, recessed through stainless steel modular wall on operating end. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification

E15 DOUBLE SIDED CAGE RACK – 160 CAGES

A. Manufacturers:

1. Lab Products, Inc.,
   742 Sussex Avenue, PO Box 639,
   Seaford, DE 19973
   Phone: (800) 526-0469
   www.labproductsinc.com
2. Tecniplast USA, PO Box 1457
   Exton, PA. 19341
   Phone: 877-669-2243
   www.tecniplastusa.com
3. Allentown Inc.,
   Route 526, POB 698,
   Allentown, NJ 08501
   Phone: (360) 691-6364
   www.acecaging.com

B. Product Description:

1. Double sided IVC mouse cage rack, 160 cages.
2. Dimensions: 77"H x 31"D x 78"W.
3. Installation: Supply Blower / Direct Exhaust

4. Provide the following accessories:
    a. Rack mounted air supply blower
    b. Thimble connection
    c. Autowatering option
    d. Polycarbonate cages (complete unit with tops, water grommet and diet delivery system)

C. Basis of Design: Lab Products RAIR Super Mouse Double Sided Cage Rack, 160 Cage Capacity. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification

E16 MODULAR WALL SYSTEM

A. Manufacturers:

1. CLAD Industries
1704 Wayneport Rd,
Macedon, NY 14502
Phone: 585-413-4359
www.cladindustries.com

2. Kloppenberg & Co
2627 West Oxford,
Englewood, CO 80110
Phone: 303-761-1614
www.kloppenberg.com

3. LYNX Product Group
650 Lake Street,
Wilson, NY 14172
Phone: 716-751-3100
www.lynxpg.com

B. Product Description:

1. Modular wall must meet ASTM specification A167 for stainless steel, alloy 304. The panel box sections shall be finished on one side with type 304 stainless steel, #4 brush finish, 16 gage minimum. The brush finish grain shall be oriented vertically on all components, except head tracks and floor tracks. Wall panels shall be insulated with a polyurethane, moisture-resistant, sound-deadening insulation. Partition panels, vents, and doors shall be of the non-progressive installation type, capable of removal and/or relocation without disturbing other panels.

2. Sectional modular wall shall be as indicated on the drawings (length and height shall be field verified) and nominally 2" thick. Manufacturer will coordinate and provide rough openings for Glassware Washer, Sterilizer, and Drying Ovens in the Glasswash Room. Manufacturer will coordinate and provide rough openings for Cage and Rack Washer, Cage and Bottle Washer, and Large Steam Sterilizer in the Vivarium. Modular wall shall completely seal openings between equipment, walls, floors and ceiling.

3. Provide 36" x 84" stainless steel doors where noted with a 24" x 24" tempered glass vision window and 24" x 24" grille (50% free area). Door hardware to be selected by Architect and furnished and installed by manufacturer.
4. Provide louvers in wall above each appliance to capture vapor and steam and allow them to be drawn into the enclosure created by walls.
5. Provide all necessary ceiling and wall trim angles, integral leveling devices (attached to vertical panels and concealed by base; shims will not be acceptable), vertical panels, horizontal panels and sanitary bases (at floor/wall intersection) for a complete and tight installation. All components to be type 304 stainless steel. Fasteners, connectors, etc. exposed to the room are not acceptable.
6. Coordinate all equipment cutouts with selected vendor's submittal data.

C. Basis of Design: CLAD Industries Modular Wall System. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E17 SCULLERY SINK

A. Manufacturers:

1. Elkay Manufacturing Company
   2222 Camden Court
   Oak Brook, IL 60523
   Phone: 630-574-8484
   www.elkay.com
2. Just Manufacturing Company
   9232 King Street
   Franklin Park, IL 60131
   Phone: 847-678-5150
   www.justsinks.com
3. Kloppenberg & Company
   2627 West Oxford
   Englewood, CO 80110
   Phone: 303-761-1615
   www.kloppenberg.com

B. Product Description:

1. Provide a free-standing scullery type sink assembly fabricated completely of type 316L stainless steel. The sink basin (double compartments with double integral drain board) shall be approximately 24" wide x 24" front to back x 14" deep each. Provide one (1) drain outlet at center of sink compartment basin, pitched bottom to drain. Provide hot and cold water faucet(s) identical to that used on lab benches; as specified on Fixture Schedule. Provide full-length 8" high backsplash with 45° sloped top and 1-1/2" wide sloping top channel rims. Sink assembly shall be supported by eight (8) adjustable bullet type stainless steel tubular legs, 1-5/8" O.D., 16 ga., that have integral leveling devices. Provide polished satin finish to all exposed surfaces.

C. Basis of Design: Elkay Sturdibilt Scullery Sink, SS8248LR, total length of 96". Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E18 GLASSWARE WASHER/DRYER

A. Manufacturers:

1. Lancer USA
   1150 Emma Oaks Trail, Suite 140
   Lake Mary, FL 32746
   Phone: 800-332-1855
   www.lancer.com
2. Steris
   5960 Heisley Road
   Mentor, OH 44060
   Phone: 800-989-7575
   www.steris.com
3. Miele, Inc.
   9 Independence Way
   Princeton, NJ 08540
   Phone: 800-991-9380
   www.miele-pro.com

B. Product Description:

1. The overall dimension of the unit shall not exceed 24" W x 65" H x 29" D. The minimum chamber size shall be 20" W x 26" H x 20" D.
2. The door, and wash chamber shall be fabricated of type 316L stainless steel. Body shall have 304 stainless steel construction with #4 polish, double-wall construction with thermal and noise insulated construction of the cabinet minimizing heat loss while operating at 63dBA. Include 20-watt fluorescent interior light mounted within an explosion proof enclosure.
3. Door shall be a single drop down door. It shall have construction that insulates door from interior processes to minimize noise and increased exterior surface temperature.
4. Unit shall be equipped with a full microprocessor control package that includes sealed program; operation and status membrane touch pads, alpha/numeric display window, cycle end/low detergent audible/visual alarm and printer. Control system shall include at least 4 pre-programmed cycles (adjustable to meet user's needs) and 42 additional user-programmed cycles, retained in memory, and named by the customer
5. All control and service components shall be accessible from a front access panel.
6. Supply the following with each unit (one of each unless otherwise noted):
   a. Drain discharge cool-down system to reduce discharges to 140F or less.
   b. Seismic tie-down kit.
   c. Starter kit.
   d. Manual transfer cart.

7. Utility Requirements:
   a. Elec: 208V/60Hz/1Ph 2kW, 10A
   b. CW: 3/4" NPT. 6 gpm max. 30-87 psig
   c. HW: 3/4" NPT. 6 gpm max. 30-87 psig
   d. PW: 3/4" NPT. 6 gpm max. 30-87 psig
   e. Drain: 1-1/2" O.D. standpipe @ 31”-15” AFF
   f. Vent: 3" O.D., 60 CFM max.
   g. Steam: 29-87 psig, max consumption 265 lbs/hr (66 lbs/cycle) – typically 1 cycle per hour
8. Unit must fit through 42” door opening for installation.

C. Basis of Design: Lancer 1300LX. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E19 ICE FLAKER

A. Manufacturers:

1. Hoshizaki America, Inc.
   618 Hwy 74 South
   Peachtree City, GA 30269
   Phone: 800-438-6087
   www.hoshizakiamerica.com
2. Ice-O-Matic
   11100 E. 45th Ave
   Denver, CO 80239
   Phone: 303-371-3737
   www.iceomatic.com
3. Scotsman
   775 Corporate Woods Parkway
   Vernon Hills, IL 60061
   Phone: 847-215-4550
   www.scotsman-ice.com

B. Product Description:

1. Unit to be air-cooled free-standing ice flaker with up to 456 lbs. of ice production per 24 hours at 70ºF air temperature and 70ºF inlet water temperature, and 700 pound (65 kg) capacity, stainless steel self-contained insulated storage bin.
2. The ice making mechanism to have a heavy duty, hermetically sealed compressor; automatic expansion valve refrigerant control; safety control thermostat to turn off ice maker should inlet water pressure become insufficient for ice production or if storage bin reaches maximum capacity. Evaporator shall be close tolerance brass cylinder with brass shell, stainless steel auger, completely insulated with polyurethane foam. Auger shall be powered by belt-driven single reduction worm gear. Condensing unit shall be air-cooled.

3. System shall be designed to operate with R-404A non-ozone depleting refrigerant. An HFC (hydrofluorocarbon) or HCFC (hydrochlorofluorocarbon) type refrigerant shall be used. CFC (chlorofluorocarbon) type refrigerant is not acceptable.
4. UL rating, NSF.
5. Installation: Free standing.
6. Utility Requirements:
   a. Elec. 1PH / 60Hz / 115V / 11A, provide 20A circuit
   b. CW 3/8" OD (Provide pre-filter for water supply)
   c. Drain 3/4" IPS- Indirect
7. Unit shall be provided with a minimum of two (2) year parts and labor warranty and a five (5) year compressor warranty.

C. Basis of Design: Hoshizaki Model F-450MAJ Flake Ice Maker with B-700SF storage bin. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E20 GAS CYLINDER CABINET

A. Manufacturers:

1. Matheson
   6775 Central Avenue
   Newmark, CA 94560
   Phone: 510-793-2559
   www.mathesongas.com
2. Spectra Gases, Inc. (Linde)
   1224 So. Main Street
   Pohatcong, NJ 08865
   Phone: 510-793-2559
   www.linde-gas.com
3. Praxair
   39 Old Ridgebury Rd.
   Danbury, CT 06810
   Phone: 800-772-9247

B. Product Description:

1. Type: Two cylinder capacity, ventilated.
2. Construction:
   a. Cabinet frame and doors constructed of 11 gage cold rolled steel.
   b. Weather resistant white polyurethane paint.
   c. Rubber mat flooring
   d. 26" W x 76" H x 18" D.
   e. Self-closing, self-latching doors.
   f. 2 cylinder brackets

g. Vertical Unistrut for positioning panels and cylinder holders.

h. Access port designed to maintain a minimum air velocity of 200 feet/minute when wide open.

3. Installation: Floor mounted with seismic restraint.

4. Ventilation: 275 scfm @ 0.1inch water column, 6”

C. Basis of Design: Model 1178F by Matheson. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E21 TALL FLAMMABLE STORAGE CABINET

A. Manufacturers:

1. Justrite Manufacturing
2454 E Dempster St., Suite 300
Des Plaines, IL 60016
Phone: 847-298-9250
www.justritemfg.com

2. Securall
5122 North State Road 39
La Porte, IN 46350
Phone: 888-326-7890
www.securallproducts.com

3. Eagle Manufacturing Co.
2400 Charles Street
Wellsburg, West Virginia 26070
Phone: 304-737-3171
www.eagle-mfg.com

B. Product Description:

1. See Specification Section 12 3553 for flammable cabinet located beneath fume hoods.

2. Type: 45 gallon capacity. Yellow cabinet shall be double walled 18 gage steel with 1 1/2” airspace. Doors shall be self-closing and self-latching on fusible link. One adjustable/removable shelf to be included. One ABS tray that fits on shelf or on bottom of cabinet to be provided. Bottom of the cabinet shall be liquid tight to a height of 2". 2” dia. high and low vent ports with flame arrestors and caps. Label in 1" high, 1/4" stroke black letters "FLAMMABLE - KEEP FIRE AWAY."

3. Installation: Floor mounted with seismic restraint.

4. Ratings: OSHA and NFPA 30 compliant; UFC Article 79.

5. Ventilation: 2” exhaust duct to 2” inch diameter connection; 25-30 cfm. Provide two exhaust connections; one on each side of cabinet, one high and one low where shown on drawings.

6. Warranty: Cabinets shall include a Ten-Year (10) Warranty

C. Basis of Design: Justrite Sure-Grip EX model 8945201. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E22 TALL CORROSIVE STORAGE CABINET

A. Manufacturers:

1. Justrite Manufacturing
   2454 E Dempster St., Suite 300
   Des Plaines, IL 60016
   Phone: 847-298-9250
   www.justritemfg.com

2. Securall
   5122 North State Road 39
   La Porte, IN 46350
   Phone: 888-326-7890
   www.securallproducts.com

3. Eagle Manufacturing Co.
   2400 Charles Street
   Wellsburg, West Virginia, 26070
   Phone: 304-737-3171
   www.eagle-mfg.com

B. Product Description:

1. See Specification Section 116010 for corrosive cabinets located beneath fume hoods.

2. 45 gallon capacity, blue cabinet shall be double walled, 18 gage steel with 1-1/2" airspace. Doors shall be self-closing and self-latching on fusible link. Two adjustable/removable shelves to be included. One ABS tray that fits on shelf or on bottom of cabinet to be provided. Bottom of the cabinet shall be liquid tight to a height of 2". Apply silkscreen signage, color red, in a conspicuous size to cabinet doors indicating "CAUTION-ACIDS/CORROSIVES".

3. Installation: Floor mounted with seismic restraint.

4. Ratings: OSHA and NFPA 30 compliant.

5. Service Requirements:

6. Ventilation: 2" exhaust duct to 2" inch diameter connection; 25-30 cfm. Provide two exhaust connections; one on each side of cabinet, one high and one low. Provide escutcheons for exhaust duct ceiling penetrations.

7. Warranty: Cabinets shall include a Ten-Year (10) Warranty

C. Basis of Design: Justrite Sure-Grip EX model 8945221. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification.

E23 MOP RACK

A. Manufacturers:

1. Global Industrial
   11 Harbor Park Drive
   Port Washington, NY 11050
   Phone: 888-277-6995
   www.globalindustrial.com

2. Elkay Manufacturing Company
   2222 Camden Court
   Oak Brook, IL 60523
   Phone: 630-574-8484
   www.elkay.com

3. Grainger
   1151 E. Columbia Ave.
   Riverside, CA 92507-2113
   Phone: 800-472-4643
   www.grainger.com

B. Product Description:

1. Stainless steel construction
2. 24” long (min.) with (3) cam-type mop/broom handle clamps.
3. Wall mounted.
4. Constructed for ease of cleanability.
5. Installation:
   a. Mount with stainless steel screws.
   b. Seal edges after mounting to close spaces where vermin may be harbored.

C. Basis of Design: Global Industries A&J Washroom Mop Holder Strip UJ12A. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E24 CLOTHES WASHER

A. Manufacturers:

1. LG Electronics USA, Inc.
   1000 Sylvan Avenue
   Edgewood Cliffs, NJ 07632
   Phone: 800-243-0000
   www.lg.com

2. Maytag Commercial Laundry
   200 M63 North MD 8600

Benton Harbor, MI 49022
Phone: 800-662-3587
www.maytagcommerciallaundry.com

3. Speedqueen, Alliance Laundry Systems LLC
Shepard Street, PO Box 990
Ripon, WI 54971
Phone: 800-590-8872
www.speedqueencommercial.com

B. Product Description:

1. Large capacity washer with stainless steel, 3.6 cu. ft. drum
2. Direct Drive Motor
3. LED Display
4. Extra wide door opening
5. Low decibel quiet operation
6. Reversible doors
7. Overall size: 27”W x 38.7”H x 31”D
8. Service Connections:
   a. Cold Water: Yes
   b. Hot Water Yes
   c. Drain: Standpipe
   d. Electrical: 120V, 12A
9. Energy Star rated.
10. UL Listed

C. Basis of Design: LG Giant-C+. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E25 CLOTHES DRYER

A. Manufacturers:

1. LG Electronics USA, Inc.
1000 Sylvan Avenue
Edglewood Cliffs, NJ 07632
Phone: 800-243-0000
www.lg.com

2. Maytag Commercial Laundry
200 M63 North MD 8600
Benton Harbor, MI 49022
Phone: 800-662-3587
www.maytagcommerciallaundry.com

3. Speedqueen, Alliance Laundry Systems LLC
   Shepard Street, PO Box 990
   Ripon, WI 54971
   Phone: 800-590-8872
   www.speedqueencommercial.com

B. Product Description:

1. Large capacity dryer with stainless steel, 7.3 cu. ft. drum
2. Direct Drive Motor
3. LED Display
4. Extra wide door opening
5. Low decibel quiet operation
6. Overall size: 27”W x 38.7”D x 30.1”H
7. Service Connections:
   a. Vent: 4” diameter
   b. Elec: 220V, 5A
8. UL Listed

C. Basis of Design: LG Giant-C+. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E26 SAFETY CENTER W/ EMERGENCY SHOWER, EYEWASH, ~~FIRE EXTINGUISHER CABINET~~

A. Manufacturers:

1. Guardian Equipment Co.
   660 North Union Street
   Chicago, IL 60610
   Phone: 312-733-2626
   www.gesafety.com

2. Water Saver Faucet Co.
   701 West Erie Street
   Chicago, IL 60610
   Phone: 312-666-5500
   www.wsflab.com

3. Haws Corporation
   1455 Kleppe Lane
   Sparks, NV 89431
   Phone: 775-359-4712
   www.hawsco.com

B. Product Description:

1. Emergency shower and eyewash units to meet the requirements of ANSI Standard Z358.1.
2. Safety center with barrier-free combination emergency shower and swing down eye/face wash ~~and matching fire extinguisher housing~~. Recessed wall-mounted, swing down eye/face wash with recessed stainless steel cabinet and stainless steel shower head and nipple. Units shall meet the requirements of the Americans with Disabilities Act (ADA).
3. Piping and fittings by Division 22.
4. Division 11 Contractor to supply shower/eyewash unit for installation by plumbing sub-contractor. Plumbing connections by Division 22.
5. Utility Requirements:
   a. CW 1" IPS
   b. Drain 1-1/2” for eyewash pan
   c. Alarm wiring
6. Accessories: Provide audible and flow alarm.

C. Basis of Design: Guardian ~~GSC2650A~~ **GBF2150**. Units manufactured by others listed in “Manufacturers” will be considered an approved equivalent provided that they meet requirements of this specification.

E27 UNDER COUNTER GLASSWARE WASHER

E28 TUNNEL WASHER

A. Manufacturers:

1. Lynx Product Group
   18 Mill Street, Middleport, NY 14105
   Phone: 716-735-9857
   www.lynxpg.com

B. Product Description:

1. Application: Heavy duty, conveyorized, hydrospray washer designed for thorough, efficient cleaning of cages, debris pans, bottles, feeder bowls and miscellaneous items used in care of laboratory animals.
2. Size:
   a. Tunnel (minimum inside clear): 37”W x 25”H minimum
   b. Conveyor Size: 36”W belt.
   c. Conveyor Speed: Variable 2 to 10 feet/minute.
   d. Sections: 15’ washer, 7’ dryer, 3’ discharge conveyor.
3. Operation: Items to be cleaned are loaded manually in inverted position on load end of conveyor belt. Items are conveyed automatically through various treatments and discharged.

a. Treatment Schedule: A treatment schedule shall be automatically programmed as follows:

b. Pre-Wash: Water recovered from the recirculated rinse tank under pump pressure flushes items to remove gross debris. Spent solution is directed to automatic drain discharge cool down system.

c. Wash: Hot detergent solution is recirculated through the jet system under pump pressure. Temperature adjustable to 190F.

d. Recirculated Rinse: Hot water is recirculated through the jet system under pump pressure. Temperature adjustable to 190F.

e. Final Rinse: Hot water from house supply is heated through a steam heat exchanger and sprayed through the jet system. Spent solution drains to recirculated rinse tank. Temperature adjustable to 195F.

C. Construction:

1. Frame, recirculating tanks, and cabinet of one piece welded stainless steel construction. Frame equipped with adjustable legs and supports for pumps, steam heat exchanger and drive mechanism.

2. Top and sides insulated with 2" thick rigid fiberglass insulation covered by a protective stainless steel jacket.

3. Splash proof doors provided for access to jet systems and interior. Tempered glass, water tight windows provided in each door for observation of treatment process. Doors insulated with 2" thick rigid fiberglass insulation and equipped with silicone bulb sealing gaskets, latches and heavy-duty self-losing hinges. Doors removable for cleaning or maintenance.

4. Each recirculating tank equipped with an automatic solution level control, safety overflow piping, manual drain valve and stainless steel steam coil heating for the recirculating treatment solutions. Automatic digital temperature controllers mounted on the operator's panel will display and monitor recirculating solution temperatures.

5. Stainless steel steam coil heating for wash and recirculating rinse tanks complete with condensate return, steam traps and strainers. Steam coils shall be designed to ASME Section VIII, Div 1, Unfired Pressurized Vessel Code and be easily removable for cleaning or maintenance. Coils shall not be welded in place.

6. Wash solutions under pressure from a minimum 10 HP pump and recirculated rinse and pre-wash systems shall be under pressure from a minimum 3 HP pump. Both pumps Worthington close coupled "Monobloc" type, or approved equal, with mechanical seals. Each pump system with a direct reading pressure gauge.

7. Pre-wash, wash and recirculating rinse sections equipped with easily accessible stainless steel drawer type screens. Screens manufactured from perforated stainless steel with perforations smaller than machined jet orifices to filter solutions and prevent jets from clogging.

8. Jet systems for pre-wash, wash and recirculating rinse sections composed of machined jets fitted into headers. Each header equipped with a quick disconnect fitting and O-ring for easy removal without use of tools. Jet properly sized and feed lines contain throttle valves to hydraulically hold down light plastic cages and steel pans to conveyor belt. Additional jets strategically placed so water bottles in baskets can be processed through washer.

9. The washer is designed to automate the task of descaling the recirculated wash and rinse tanks. When activated, the wash tank drains and refills with fresh hot tap water. The pre-wash and final rinse are disabled, the recirculating pumps start, and descaling acid is added to each tank and sprayed while the belt runs continuously for a thorough cleaning. Descaling takes place for a preset time determined by the end-user. When each tank completes draining, internal spray jets are activated to assist in removing any remaining debris from the interior of the tank. The tank remains empty until the "complete" button is pressed, filling the tank and allowing the unit return to normal operation.

10. Electrical control system:
    a. Within control box are transformer for 1/60/115 volt control circuit, magnetic starters with overload protection for all motors and all other electrical components required for operation.
    b. Unload end is equipped with a drive system emergency stop button and warning lights.

11. Safety features:
    a. Emergency push/pull stop buttons at both load and unload ends of unit to terminate all process and conveyance functions. Processing resumed by resetting emergency stop button and activating cycle start button.
    b. Each chamber door with a disconnect switch to terminate all process and conveyance functions upon opening of any door. Processing cannot be resumed unless all doors are fully closed. All emergency conditions are audibly and visually enunciated.

12. Final rinse jet system consists of spray headers with machined jets and a throttle valve in the line for optimum water use. System equipped with a steam heat exchanger to raise house hot water supply temperature by 60-80F. Heat exchanger supplied with temperature gauge and steam throttle valve to adjust final rinse system temperature.

13. Provide PND modulating steam valve on final rinse water to insure constant pressure and temperature.

14. Drive system shall consist of a minimum 1/3 HP DC motor, gear reducer, automatic safety overload clutch and variable speed drive.

15. Conveyor system shall include a stainless steel flat wire mesh belt, sprockets at both drive and idler ends for positive tracking of belt, adjustable take-up bearings on idler end, and stainless steel guides and supports along entire length. A stainless steel drain pan with a 2" drain connection under the entire length of conveyor.

16. Three (3) detergent injection ports and dry electrical contacts for installation of automatic detergent injection. Washer sump equipped with two (2) 1" NPT fittings/couplings for connection of external devices.

17. Water line to be protected from hammering by using slow closing valves.

18. Low water cut-off for both recirculating that will cease operations and automatically fill tank to proper level. Status lights shall indicate which tank is low and operations will resume automatically when tank is full.

19. Stainless steel baffles and rubber curtains between each treatment section and at both ends. Curtains manufactured from 1/8" thick slit neoprene and with the baffles minimize the carry-over of water.

20. All serviceable components located on one side of washer inter-piped and inter-wired so that only one connection is required for each service and utility except drain.

21. Stainless steel trim flanges to enclose opening between machine and service wall opening.

22. Discharge of wash treatment pump equipped with a stainless steel automatic self-cleaning screen, 3-1/2" diameter X18" long manufactured from perforated stainless steel with 1/16" diameter perforations. Screen shall accumulate debris prior to jet system and be automatically flushed at time periodic intervals. Fully ported, motorized ball valves shall direct the solution flow to jet system or drain.

23. All pumps, valves, piping and other components that come in contact with recirculating solutions shall be furnished in stainless steel.

24. Shipped in sections for entry into building. Sections shall then be welded into place on site to eliminate any possibility of leakage.

25. 3' long powered discharge extending the main conveyor past the dryer section.

26. Temperature guarantee for both recirculating tanks. If recirculating solution temperature drops below set temperature, conveyor belt shall temporarily stop until recirculating solution reaches proper temperature. Status lights will indicate which tank is not at proper temperature.

27. 7' long insulated stainless steel hot air dryer section guaranteed to dry plastic cages 100%. The system shall consist of a steam to air heat exchanger, a plenum system and 5 HP minimum air blower capable of minimum 1600 CFM air flow under recirculation at 230F. An additional blower shall remove excess water remaining in plastic cages exiting recirculated air dryer. Blow-off system incorporates a pressure blower and air knife jets designed to evaporate remaining water in cage. This feature guarantees to deliver the plastic cage 100% dry at discharge of dryer, permitting immediate filling of cage. All air ducting shall be stainless steel, complete with dampers as required. Interior of dryer constructed to permit complete draining. Conveyor belt continuous through washer, dryer and discharge conveyor.

28. Exhaust plenum provided for exhausting all washer and dryer sections, including a canopy exhaust at load end, to single building exhaust connection. Top of exhaust plenum shall not exceed 8' AFF at connection to building exhaust. All exhaust connections to sections shall include manual dampers for balancing exhaust system.

29. Solid-state microcomputer control system that monitors and automatically controls all process operations and functions. Provide primary and secondary microprocessor control panels on load and unload ends of the washer, respectively. Cycle phase times, temperatures and other key process parameters are programmable and may be locked in by supervision. A 12 cycle menu of treatment processes may be programmed and

retained to permit operating personnel to accommodate a wide variety of load and processing requirements. Cycle programming shall be controlled by access code to insure process integrity. Each cycle program may be reviewed and printed on demand. The highly visible color touch panel screen or LED screen shall display cycle program data on demand and real time in process cycle performance. Programming may be in standard AM/PM or military time, temperature in Fahrenheit or Centigrade. Times and temperatures shall expressed in minutes/seconds and tenths of a degree increments respectively. An internal battery shall back up all cycle memory for up to one (1) year and permit completion of a cycle upon restoration of power after a power disruption. All cycle deviations are alarmed visually and audibly, recorded and must be acknowledged by the operator. A built-in service diagnostic program, accessible by service access code, shall be provided and displayed to permit system calibration and verification of satisfactory component operation. Provide an RS485 port to down load cycle data to a remote computer. All data from control system to communications port shall be in ASCII format compatible with PC/DOS support software. Provide 0.1 amp Form C dry contacts to communicate with building DDC system and send a signal when unit is turned on or off.

30. Cold water injection system to cool effluent from pre-wash section. System automatically activated when washer is turned on and controlled and recorded by microprocessor. In addition, a cold water injection system mounted in line to the drain line to cool spent recirculated treatments shall be controlled by an actuated ball valve which automatically opens when sump valves are open. By mixing with cold water, all drain discharges are cooled to a minimum of 140F, or less, before gravity draining.

31. Configured to accept future pH neutralization and detergent concentration control system with all necessary couplings, electrical and data connections.

32. A photoelectric switch shall be located at the end of discharge conveyor to stop powered conveyor drive when an item reaches end of conveyor. Photoelectric switch can be activated/deactivated by microprocessor and/or a control panel switch depending upon whether cage components continue through to the bedding dispenser or not.

33. ~~Equipped with a minimum 70% efficient vapor condenser with coil using building chilled water at 55F~~.

34. Integral air compressor, if required.

D. Materials (all stainless steel, S.S., type 304):

Item	Material
Frame	2”x2” x3/16” S.S. Angle
Tanks	12 Gauge S.S. #3 Fin.
Cabinets	14 Gauge S.S. #3 Fin.
Recirculating Pump Piping	S.S.
Internal Water & Steam Piping	S.S.
External Steam Piping	Schedule 80 Black Iron
External Water Piping	S.S.
Spray Jets	S.S.
Internal/External Drain Piping	S.S.
Steam Coils	7 gauge S.S. #2B Fin.
Barrier Flange/Insulated Jacket	20 Gauge S.S. #3 Fin.

Treatment Pump	S.S.

E. Utility Requirements:

E	3/60/480V.
ST	2" NPT (30-80 PSI dynamic, 1,000 lbs./hr).
Condensate	2 @ 1" NPT.
HW	1-1/2" NPT, 35-60 PSI, 50 GPM @ 140°F ± 5°F (fills only), HW 10-12 GPM continuous.
CW	1-1/2" NPT, 35-60 PSI, 35 GPM @ 50°F ± 5°F.
~~CHWS~~	~~2-1/2"FPT. (Required with vapor condenser #6ee.)~~
~~CHWR~~	~~2-1/2"FPT. (Required with vapor condenser #6ee.)~~
D	2 @ 4" Floor Drain (Minimum), 50 GPM.
EXH	18" I.D. (Flow Rate 2,200 CFM saturated vapor @ 180°F. Static Pressure: 2-3 IWC).
SPCL	Dry contacts for DDC.
DATA	Ethernet Jack

F. Basis of Design: shall be equal to Lynx 536LXi Tunnel Washer, robotic cage handling ready. Units manufactured by others listed in "Manufacturers" will be considered an approved equivalent provided that they meet requirements of this specification

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Check for shipping damage. Reject units with scratches, dents or other defects that cannot be readily corrected.

3.2 INSTALLATION

A. General:

1. Deliver equipment to the job site freight paid.
2. Uncrate equipment and place in locations shown on drawings. Remove crating materials and packing debris.
3. Install equipment according to Shop Drawings and manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels, but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
4. Comply with requirements in CBC for seismic anchorage of equipment.

5. Comply with requirements in Divisions 22, 23 and 26 Sections for installing water and steam service fittings and electrical devices.
6. Provide cooling water system for drain discharge exceeding 140 degrees F.
7. Install to meet Applicable Codes for seismic requirements.

3.3 ADJUSTING AND CLEANING

A. Verify installation and operation of all equipment. Replace items which do not operate properly, or have defacing marks or damage which cannot be repaired as determined by University's Representative. Replace items at no cost to University.

B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by University's Representative.

3.4 PROTECTION

A. Protect laboratory equipment in place until Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's personnel to operate, adjust, and maintain laboratory equipment.

B. Provide a hands-on, start-up session with supplier, maintenance personnel, and end users. There shall be a separate operational session and maintenance session.

C. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 11 5300

SECTION 11 5313 - LABORATORY FUME HOODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bench-top laboratory fume hoods.
2. Fume hood base cabinets.
3. Fume hood base stands.
4. Work tops within fume hoods.
5. Laboratory sinks and cup sinks in fume hoods.
6. Water, laboratory gas, and electrical service fittings in fume hoods.
7. Piping and wiring within fume hoods for service fittings, light fixtures, fan switches, and other electrical devices included with fume hoods.

B. Related Sections:

1. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring fume hoods.
2. Division 09 Section "Resilient Base and Accessories" for resilient base applied to fume hood base cabinets.
3. Division 12 Section "Laboratory Casework" for fume hood base cabinets, including work tops, sinks, and service fittings.
4. Division 23 Sections for fume hood duct connections, including ducts and exhaust fans.
5. Division 23 and 26 Sections for connecting service utilities at back of fume hoods. Piping and wiring within fume hoods are specified in this Section.

1.2 PERFORMANCE REQUIREMENTS

A. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110 at a release rate of 4.0L/min.:

1. Face-Velocity Variation: Not more than 20 percent of average face velocity.
2. Sash Position: Fully open.
3. As-Manufactured (AM) Rating: AM 0.01 (0.01 ppm)

B. Static-Pressure Loss: Not more than 1/2-inch wg at 100-fpm face velocity when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

C. Structural Performance: Provide fume hood components capable of withstanding the following loads without permanent deformation, excessive deflection, or binding of cabinet drawers and doors:

D. Seismic Performance: Fume hoods, including attachments to other work, shall withstand the effects of earthquake motions determined according to California Building Code

1. Design earthquake spectral response acceleration, short period (Sds) for Project is as required by the California Building Code
2. Component Importance Factor is 1.5.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For laboratory fume hoods. Include plans, elevations, sections, details, and attachments to other work.

1. Provide 3/4 inch = 1'-0" (1:20) scale elevations of individual and battery of fume hoods showing cross sections, rough-in and anchor placements, tolerances, and clearances. Indicate relation to other laboratory equipment, surrounding walls, windows, doors, and other building components.
2. Provide ¼ inch = 1'-0" (1:50) rough-in plan drawings for coordination with trades.
3. Provide 3 full size sets of black line shop drawing prints.
4. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports. Include calculations demonstrating that anchorages comply with seismic performance requirements, stamped by a licensed Professional Engineer. This engineer shall perform and submit structural calculations to document the fume hood systems and proper anchorage to building components..
5. Indicate locations and types of service fittings together with associated service supply connection required.
6. Indicate duct connections, electrical connections, and locations of access panels.
7. Include roughing-in information for mechanical, plumbing, and electrical connections.
8. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from above items.
9. Include layout of fume hoods in relation to lighting fixtures and air-conditioning registers and grilles.
10. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples for Initial Selection To be selected by Architect.

D. Samples for Verification: For fume hood exterior finishes and work top material, in manufacturer's standard sizes.

1. Work Surface Samples: Submit 3 inch by 5inch product sample of each color and type of work surface material.

2. Finish Samples: Submit 3 inch by 5 inch samples of color of finish for fume hoods, and for other pre-finished equipment and accessories for selection by Architect.

E. Product Test Reports: Showing compliance with specified performance requirements for as manufactured containment and static pressure loss based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.

F. Source quality-control reports.

G. UL 1805: Submit written verification of compliance to UL 1805.

H. Life Cycle Tests: Provide independent test data for sash hardware components such as cables and pulleys.

I. Manufacturer’s Qualifications: Provide documentation from Fume Hood Manufacturer indicating they have supplied for installation, the product described in this section on six (6) similar projects in the past three (3) years.

J. Maintenance Manuals: Provide written instruction manuals outlining operating and safety instructions and proper maintenance procedures.

1.4 QUALITY ASSURANCE

A. Source Limitations for Laboratory Fume Hoods: Obtain fume hoods from single manufacturer.

1. Obtain from same source from same manufacturer as laboratory casework specified in Division 12 Section "Laboratory Casework."

B. Product Standards: Comply with SEFA 1, "Laboratory Fume Hoods - Recommended Practices." Provide fume hoods UL listed and labeled for compliance with UL 1805.

C. Manufacturer's Qualifications: Modern plant with proper tools, dies, fixtures, and skilled production staff to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:

1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.

2. Ten installations of equal or larger size and requirements in the previous three years.

D. Installer's Qualifications: Factory trained and certified by the manufacturer.

E. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements of Underwriters Laboratories (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.

F. Safety Glass: Products complying with testing requirements in 16 CFR 1201 for Category II materials.

1. Permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Schedule delivery of fume hoods and equipment so that spaces are sufficiently complete that material can be installed immediately following delivery.

B. Storage: If fume hoods must be stored in other than installation areas, store only in areas where it will prevent damage or soiling of fume hoods.

C. Handling: Keep covered with polyethylene film or other protective coating as necessary to protect fume hood from soiling or damage during handling and installation.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for lateral support of fume hoods.

B. Coordinate installation of fume hoods with laboratory casework, fume hood exhaust ducts, and plumbing and electrical work.

C. All overhead mechanical, electrical and plumbing rough-in work shall be complete prior to fume hood delivery.

D. All mechanical, electrical and plumbing rough-in work required is to be complete prior to delivery of materials.

E. Walls and partitions must be in place and finished with at least the primer coat of paint. If finish painting is to take place after laboratory furnishing installation, protect the fume hoods by covering and masking prior to commencement.

F. All necessary blocking or backing must be installed within wall partitions prior to delivery of casework and furnishings.

G. Ceiling grid must be in place prior to fume hood installation.

H. Overhead lighting must be installed and connected prior to casework installation.

I. All flooring required to be placed under lab casework and furnishings must be installed prior to material delivery and casework installation.

J. Wet operations to be performed must be complete prior to material deliveries.

1.8 WARRANTY

A. Provide a 1-year warranty against defects in materials and workmanship.

1.9 EXTRA MATERIALS

A. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kewaunee Scientific Corporation - Laboratory Division
Statesville, North Carolina 28677
(704) 873-7202
www.kewaunee.com

2. Or Equal

2.2 MATERIALS

A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.

B. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on the exposed face, and having a flame-spread index of 25 or less per ASTM E 84.

C. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, non-specular finish.

1. As specified in Section 12 3553

D. Glass: Clear, laminated tempered glass complying with ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with two lites not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.

2.3 INTERIOR BYPASS

A. Restricted Bypass: Provide a restricted bypass on all variable air volume (VAV) with a vertical rising sash.

B. Bypass Material: Manufacturer’s standard material. If constructed with steel, provide with a urethane powder coat finish o match color of hood liner.

2.4 FABRICATION - BENCHTOP CHEMICAL FUME HOODS

A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods shall be capable of being partly disassembled as necessary to permit movement through a 35-by-79-inch door opening.

B. Steel Exterior: Fabricate from steel sheet, not less than 0.0478 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.

C. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.

D. Splay top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.

E. Interior Lining: Provide one of the following unless otherwise indicated:

1. Polyester liner: Reinforced glass polyester panel; smooth finish and white color in final appearance. Flexural strength: 21,000 psi (144,790 kPa). Flame spread: 25 or less per UL 723 and ASTM E84-80. Manufactured by Rochling-Glastic, Haysite, Morrison Molded Fiberglass, WS Hampshire Inc. "Wesliner 1125". Provide gasketed access panels in the liner for access to valves and fixtures. Panels shall be of the same material as the liner and be provided with a PVC gasket to eliminate air leakage and retain liquids inside the hood.
2. Kemglass by Kewaunee

Punch fume hood lining side panels to receive service fittings and remote controls. Provide removable plug buttons for holes not used for indicated fittings.

F. Rear Baffle: Unless otherwise indicated, provide baffle, of same material as fume hood lining, at rear of hood with openings at top and bottom for airflow through hood. Secure baffle to cleats at rear of hood with stainless-steel screws. Fabricate baffle for easy removal for cleaning behind baffle.

1. Provide preset baffles.

G. Exhaust Plenum: Full width of fume hood and with adequate volume to provide uniform airflow from hood, of same material as hood lining, and with duct stub for exhaust connection.

1. Collar: Round. Fabricate collar of stainless steel and the same gage, 18 gage minimum, as the building exhaust duct connection.
2. Duct Transition: Round duct size as indicated in the Fume Hood Schedule. Fabricate transition of the same material and gage, 18 gage minimum, as the building exhaust duct connection.

H. Bypass Grilles: Provide grilles at bypass openings of bypass and restricted bypass fume hoods.

I. Sashes:

1. Full view type with clear, unobstructed, side to side view of fume hood interior and service fixture connections. Refer to the Fume Hood Schedule on the Drawings for type and height of sash at each fume hood.

2. Vertical Sliding Sash:

   a. 2 inches maximum height bottom sash rail, 18gage thick steel with a polyurethane powder coat finish. Provide integral formed flush pull the full width of bottom rail. Set safety glass into rails in deep form, extruded polyvinyl chloride glazing channels.

   b. Sash Stops: Provide sash stops at operating sash opening. Refer to the fume hood schedule for requirements. Sash stops shall be defeat-able to allow for fume hood set-up. Provide an acid resistant decal indicating the operating or design sash opening.

   c. Contractor to coordinate installation of automatic sash positioner system.

3. Glaze with 7/32” thick laminated safety glass.

4. Counterbalance vertical-sliding sash with sash weight and stainless-steel cable system to hold sash in place regardless of position. Provide ball-bearing sheaves, plastic glides in stainless-steel guides, and stainless-steel lift handles. Provide rubber bumpers at top and bottom of each sash unit.

J. Airfoil: Unless otherwise indicated, provide airfoil at bottom of fume hood face opening with 1-inch space between airfoil and work top. Sash closes on top of airfoil, leaving 1-inch opening for air intake. Airfoil directs airflow across work top to remove heavier-than-air gases and to prevent reverse airflow.

1. Fabricate airfoil from stainless steel.

K. Light Fixtures: Provide T-5 fluorescent light fixtures, of longest practicable length; complete with tubes at each fume hood. Shield tubes from hood interior with 1/4-inch- thick laminated glass or 3-mm-thick tempered glass, sealed into hood with chemical-resistant rubber gaskets. Provide units with fluorescent tubes easily replaceable from outside of fume hood.

1. Interior Fixture Finish: White, high reflecting plastic enamel.

2. Size: Largest possible up to 48 inches for hoods with superstructures up to 6 feet Provide (2) 36inch fixtures for hoods with 8 foot superstructures.

3. Illumination: 80 footcandle (860lx) minimum average at the work surface.

4. Light Switch: Toggle type, single pole 120 VAC, 20 AMP, Gray in color with stainless steel brushed finished flush face plate. Mount on left side of fume hood side post.

5. Provide fluorescent tubes with color temperature of 3500 K and minimum color rendering index of 85.

L. Receptacles:

1. Unless otherwise noted, provide each hood with receptacle quantities as follows:

   a. 48 inch wide hoods: Provide one duplex receptacle each side post near the bottom.

b. 60 inch wide and greater hoods: Provide two (2) duplex receptacles each side post near the bottom. Receptacles on each side shall be wired alternately.

c. Provide a dedicated receptacle on top of all hoods for safety monitor and alarm.

2. Receptacle: NEMA-5-20R, three wire grounding type receptacle rated at 120VAC at 20 AMP with ground fault interruption (GFI), Gray in color with a or white plastic flush face plate. Install receptacles with the ground outlet above the power slots. Label each receptacle per Division 26 specifications with the associated circuit number.

M. Factory install receptacles, lighting, electrical fixtures and wiring in accordance with all applicable state and local codes and Division 26 specifications. Terminate wiring in a single service junction box on top of the fume hood roof for in-the-field point of connection. All electrical fixtures shall be UL listed and labeled.

N. Service Fixtures and Piping:

1. Fume hoods shall be factory pre-piped in accordance to all state and local codes. Refer to the Drawings for services required at each fume hood. Terminate piping 2 inches above the fume hood roof for in-the-field point of connection. Install protective rubber piping end caps for shipment. Piping materials and installation for each type of service shall be as specified under Division 22. Pressure test all pre-piped lines in the factory.

2. Control Valves: Control valves shall be mounted on the front panel of the fume hood, with all components subject to wear accessible from the exterior of the hood. Straight or 45 degree angle mounted fixtures are acceptable. The centerline of the valve inlet and outlet shall be parallel and 1-1/8 inches apart. Valves shall have a threaded collar to hold the valve in place.

3. Service fixtures outlets within the fume hoods interior shall have color coded, acid and solvent resistant plastic coating, applied over fine sandblasted surface, properly cleaned. Surfaces to be coated shall be sprayed and baked three times with minimum coating thickness of 6 mil.

4. Color coding of hood interior service fixtures and remote control valves shall be as specified for Laboratory Service Fixtures in the Laboratory Casework and Furnishings Section of this Specification.

O. Base Cabinets: Comply with Division 12 Section "Laboratory Casework”.

P. Work Top:

1. As specified in Section 12 3553 Fixed Laboratory Casework.

Q. Cup Sinks: Material and size as indicated.

1. Provide epoxy cup sinks with polypropylene strainers and integral tailpieces.

2. As specified in Section 12 3553 Fixed Laboratory Casework.

R. Filler Strips: Provide as needed to close spaces between fume hoods or fume hood base cabinets and adjacent building construction. Fabricate from same material and with same finish as fume hoods or fume hood base cabinets, as applicable.

S. Ceiling Extensions: Provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.

T. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.

U. Comply with requirements in Divisions 23 and 26 Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring. Install according to Shop Drawings. Securely anchor fittings, piping, and conduit to fume hoods unless otherwise indicated.

V. Unit will be equal to Supreme Air LV as manufactured by Kewaunee.

2.5 ADA ACCESSIBLE HOODS

A. Accessible hoods shall be as detailed on the drawings and as described under Article 2.03, Bench-top Chemical Fume Hoods, unless modified under this Article.

B. Light switches, electrical receptacles, and service fixtures shall be mounted no higher than 48” above finished floor.

C. Operating controls shall be reachable per CBC 11B.308 reach requirements face of fume hood 48” max. Others obstructed high reach 11B.308.2.2.

D. Unit will be equal to Hopec as manufactured by Kewaunee.

2.6 CHEMICAL-RESISTANT FINISH

A. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.

B. Preparation: Clean steel surfaces, other than stainless steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply fume hood manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.

2. Colors for Fume Hood Finish: As selected by Architect from manufacturer's full range.

2.7 ACCESSORIES

A. Provide service fittings with exposed surfaces, including fittings, escutcheons, and trim, finished with acid- and solvent-resistant powder coating complying with requirements in SEFA 7 for corrosion-resistant finishes or made from PVDF.

B. Airflow Indicator: Provide each fume hood with airflow indicator of one of the following type(s):

1. Indicator Type: Thermal anemometer that measures fume hood face velocity and indicates whether it is below normal, normal, or above normal.

2. Indicator Type: Thermal anemometer that measures fume hood face velocity and displays data as digital readout.

C. Safety Monitor/Alarm System

1. Variable Air Volume Hoods: Each fume hood shall be equipped with a velicity control and safety audible/visual alarm unit which is to be provided under Division 23. Provide factory cut outs in the front of the hood for field mounting of the unit. Coordinate location and size of cut out with Division 23. Connection of control and safety alarm unit to sensors and controls valves shall be under Division 23.

D. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.

E. Bypass Grille Blank-off Panel: Provide fume hoods with blank-off panel on bypass grille designed for use with sash stops to reduce exhaust air volume and provide design face velocity with sash at 50 percent open position.

F. Provide a permanent acid resistant decal or plate attached to fume hood exterior with condensed information covering the following:

1. Recommended locations for apparatus and accessories

2. Recommended safe operating procedures.

3. Use of sash

4. Baffle settings

2.8 FUME HOOD BASE AND SPECIAL CABINETS

A. Flammable Liquids Storage Cabinet:

1. Conform to OSHA Regulations and the requirements of NFPA 30-2003 Chapter 6-3, National Fire Protection Association, Flammable and Combustible Liquids Code. Cabinets shall be Factory Mutual (FM) approved or Underwriters Laboratories (UL) listed. Cabinets shall limit the internal temperature at the center, one inch (25mm) from the top to not more than 325 degrees Fahrenheit (162.8 degrees Celsius) when subjected to a ten-minute fire test that simulates the fire exposure of the standard time-temperature curve specified in NFPA 251.

2. Provide 1-1/2 inch diameter, minimal, insulated, NPT flexible stainless steel vent pipe routed from bottom of cabinet directly to the outside with make-up air supplied to the top, in accordance with NFPA91.

3. Casing: Bottom, top, back, door, and sides of cabinet shall be constructed of metal and finished in the same manner as the metal casework herein before specified, provided that the bottom, top, door, back and sides of the cabinet shall be at least 18 gage sheet steel and shall be double-walled, with 1-1/2 inch air space. Joints shall be riveted, welded or made tight by equally effective means.
4. Provide self-closing doors.
5. Ground (to structure) and bond cabinet.
6. Flame arrestor on cabinet vent outlet.
7. Adjustable, full width, metal shelf supported with “locking” clips to avoid inadvertent removal.
8. Apply silkscreen signage, color red, in a conspicuous size to cabinet doors indicating “FLAMMABLE – KEEP FIRE AWAY”.
9. Door: Provide with continuous piano hinge, three point latch mechanism integrated into lever handle with door sill raised at least 2 inches above the bottom of the cabinet to retain spilled liquid within the cabinet. When more than one door is used, there shall be a rabbetted overlap or not less than one inch Doors shall be equipped with a means of latching and hinges shall be constructed and mounted in such a manner as to not lose their holding capacity when subjected to fire exposure.
10. Finish: Finish as specified for metal laboratory casework except interior and shelf finish shall be three-mils thick. Color to match fume hood.

B. Corrosive Storage Cabinet

1. Provide 1/4 inch thick white polypropylene lining on interior surfaces.
2. Provide a 2 inch polypropylene vent pipe at the outside rear of the cabinet with one inlet. Secure vent pipe inlets to back of cabinet with polypropylene locking nuts. Extend vent pipe 2 inches above the work surface.
3. Doors: Provide with polypropylene or ABS roller catches with stainless steel screws.
4. Bottom: Provide with 1/4 inch thick heat welded, polypropylene or ABS plastic pan, liquid tight removable, 1 inch deep.
5. Removable back panel.
6. Finish: Finish as specified for metal laboratory casework. Color to match fume hood.
7. Identification: All under-counter ventilated cabinets shall be marked with conspicuous lettering: “CAUTION-ACIDS/CORROSIVES”.

2.9 CANOPY HOODS

1. Fabricate, as detailed, of (18 gauge) thick, Type 304 stainless steel with a Number 4 finish.
2. Weld all exposed corners and ground smooth.
3. Support from steel rods attached to structure above and from brackets attached to adjoining wall. Refer to detail on Drawings.

2.10 SOURCE QUALITY CONTROL TESTING OF EPOXY RESIN WORK SURFACE

1. As specified in Section 12 3553 Fixed Laboratory Casework.

2.11 SOURCE QUALITY CONTROL TESTING OF POLY RESIN LINER

1. Test Procedure:
   a. Test Number 1 - Spills and Splashes:
      1) Suspend in a vertical plane a 42 inch (horizontal) by 12 inch (vertical) panel divided into ¾ inch wide vertical columns.
      2) Apply 5 drops of each reagent listed with an eye dropper.
      3) Apply liquid reagents at top of panel and allow to flow down full panel height. (CAUTION! Flush away any reagent drops.)
   b. Test Number 2 - Fumes and Gases:
      1) Divide 24 inch by 12 inch panel into 2 inch squares.
      2) Place 25 milliliters of reagent into 100 milliliter beakers and position panel over beaker tops in the proper sequence. Note: Beaker pouring lip permits atmospheric oxygen to enter and participate in the reaction of the reagent fumes.
2. After 24 hours remove panel, flush with water, clean with naphtha and detergent, rinse, wipe dry and evaluate.
3. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:
   a. No Effect: No detectable change in surface material.
   b. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
   c. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
   d. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
   e. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.
4. Test Results: Submit a report of the test results. The results shall be equal to or better than the following:

	REAGENT LIST CONCENTRATIONS BY WEIGHT	TEST 1 RATING SPILLS	TEST 2 FUMES
a.	Sodium Hydroxide Flake	No Effect	No Effect
b.	Sodium Hydroxide, 40%	No Effect	No Effect
c.	Sodium Hydroxide, 20%	No Effect	No Effect
d.	Sodium Hydroxide, 10%	No Effect	No Effect
e.	Ammonium Hydroxide, 28%	No Effect	No Effect
f.	Methylene Chloride	No Effect	No Effect
g.	Chloroform	No Effect	No Effect
h.	Carbon Tetrachloride	No Effect	No Effect

i.	Monochlorobenzene	No Effect	No Effect
j.	Tincture of Iodine	No Effect	Good
k.	Methyl Alcohol	No Effect	No Effect
l.	Ethyl Alcohol	No Effect	No Effect
m.	Butyl Alcohol	No Effect	No Effect
n.	Phenol, 85%	No Effect	Excellent
o.	Cresol	No Effect	No Effect
p.	Sodium Sulfide	No Effect	No Effect
q.	Furfural	Excellent	Excellent
r.	Dioxane	No Effect	No Effect
s.	Zinc Chloride	No Effect	Excellent
t.	Benzene	No Effect	No Effect
u.	Toluene	No Effect	No Effect
v.	Xylene	No Effect	No Effect
w.	Gasoline	No Effect	No Effect
x.	Naphthalene	No Effect	No Effect
y.	Methylethyl Ketone	No Effect	No Effect
z.	Acetone	No Effect	No Effect
aa.	Ethyl Acetate	No Effect	No Effect
bb.	Amyl Acetate	No Effect	No Effect
cc.	Ethyl Ether	No Effect	No Effect
dd.	Silver Nitrate, 10%	Excellent	Excellent
ee.	Dimethylformamide	Excellent	Excellent
ff.	Formaldehyde, 37%	No Effect	No Effect
gg.	Formic Acid, 88%	No Effect	Excellent
hh.	Acetic Acid, Glacial	No Effect	No Effect
ii.	Dichloroacetic Acid	No Effect	Excellent
jj.	Chromic Acid, 60%	No Effect	No Effect
kk.	Phosphoric Acid, 85%	No Effect	No Effect
ll.	Sulfuric Acid, 33%	No Effect	Excellent
mm.	Sulfuric Acid, 77%	No Effect	No Effect
nn.	Sulfuric Acid, 93%	No Effect	No Effect
oo.	Hydrogen Peroxide, 30%	No Effect	No Effect
pp.	Acid Dichromate	No Effect	No Effect
qq.	Nitric Acid, 20%	No Effect	Excellent
rr.	Nitric Acid, 30%	No Effect	No Effect
ss.	mm & tt Equal Parts	No Effect	Good
tt.	Nitric Acid, 70%	No Effect	Good
uu.	Hydrofluoric Acid, 48%	No Effect	Excellent
vv.	Hydrochloric Acid, 37%	No Effect	Excellent

2.12 SOURCE QUALITY CONTROL

A. Demonstrate fume hood performance before shipment by testing one fume hood for each type required according to ASHRAE 110 as modified in "Performance Requirements" Article. Provide testing facility, instruments, equipment, and materials needed for tests.

B. Evaluation of standard product shall have been conducted in the manufacturer's test facility in accordance with the method prescribed in ANSI/ASHRAE 110-1995.

C. Hoods shall achieve a rating of 4.0 AM 0.05 with 4.0 being the tracer gas release rate in liters per minute, AM identifying an "As Manufactured" test, and 0.05 indicating the maximum level of tracer gas, in parts per million, in the breathing zone.

2.13 SOURCE TESTING OF FUME HOOD SOUND LEVELS

A. Provide the following historic certified sound test data for each size and type of fume hood:

1. Background sound pressure level readings for the test facility with exhaust system operating but without connection to the fume hood.

2. A second set of readings recorded with the fume hood connected and operating and the sensor located 36 inches (900 mm) in front of the sash assembly.

3. Certified report: Octave band sound pressure level, Db re 20 micro Pa in the 31.5 to 8,000 Hertz frequency range, for the fume hood operating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fume hoods according to Shop Drawings and manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels, but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Accessory installation: Install accessories and fixtures in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. Field test installed fume hoods according to "Flow Visualization and Velocity Procedure" requirements in ASHRAE 110.

1. Test one installed fume hood, selected by University’s Representative, for each type of hood installed, according to ASHRAE 110If tested hood fails to meet performance requirements, field test additional hoods as directed by University’s Representative.

2. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.

3. After making corrections, retest fume hoods that failed to perform as specified.

4. Provide written results of each fume hood test.

3.4 ADJUSTING AND CLEANING

A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.

B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by University's Representative.

3.5 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent damage to equipment from exposure to other construction activity.

B. Advise Contractor of procedures and precautions for protection of material and installed fume hoods from damage by work of other trades.

END OF SECTION 11 5313

SECTION 11 5325 – WALK-IN ENVIRONMENTAL ROOMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes Cold Room, accessory equipment, and components, for laboratories as indicated on the Drawings. The units shall be equipped with water-cooled condensers.

1. The Cold Room shall be designed to operate at 2-4 degrees Celsius; plus or minus 1 degree Celsius.
2. Cold Room equipment shall be connected to the emergency power.
3. The Cold Room shall be furnished complete and ready for installation with all accessories required for installation.
4. The equipment locations, as shown on the plans, shall be checked by the Cold Room manufacturer. Exact locations shall be determined by the dimensions of the equipment approved and the layout before apparatus is installed. The Cold Room manufacturer shall be solely responsible for the accurate installation and correct operational aspects of his equipment and shall correct deficiencies without any recourse to the Owner. Consult the architectural and structural drawings for all dimensions, locations of partitions, locations of pipes and duct work.
5. The Cold Room manufacturer shall furnish shop drawings for all equipment being furnished and shall also prepare and submit for approval scaled shop drawings representing the actual manner in which the systems and equipment are to be installed. Shop drawings shall show accurately and in detail the dimensions, section, arrangements and elevations of all prefabricated Cold Room and shall include all measurements, roughing-in diagrams and other necessary details for use by other trades. The Cold Room manufacturer shall obtain the Owner's Representative's approval for all routing and movement of materials into the building before any materials or equipment are purchased, fabricated, assembled or installed.
6. The Cold Room manufacturer shall have a factory trained field service technician on the premises to supervise the installation of all equipment and assist the other trades as to the proper piping rough-in for equipment.
7. A factory trained representative of the equipment manufacturer shall provide one (1) onsite equipment demonstration to Owner.
8. The Cold Room manufacturer shall be responsible for providing and field wiring all electrical devices provided with the room.
9. The CER manufacturer shall be responsible for all refrigeration piping and connections between condensing unit and evaporator and terminating condensate drain line at condensate drain. Location of condenser and routing of condensate drain line to condensate drain shall be coordinated with Owner's Representative and General Contractor.

10. The Cold Room manufacturer shall be responsible for blocking in the pre-fabricated partitions to mount any wall-mounted items. Coordinate blocking requirements for wall mounted items with the laboratory furniture manufacturer.
11. Delivery and installation of the equipment shall be so performed as to avoid delay to the work of other contractors. The Cold Room contractor shall be responsible for receiving, uncrating, and setting-in-place this equipment.
12. The Cold Room contractor shall coordinate their work with the General contractor and all supporting contractors, providing all information and supervision necessary as required to assure proper and timely installation without delay to the project or other contractors.
13. Provide supply and exhaust collars as required. All penetrations shall be sealed to prevent vapor/moisture condensation.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for the following:
   a. Equipment bases.
   b. Requirements for slab depressions.
2. Division 05 Section "Metal Fabrications" for equipment supports.
3. Division 12: Laboratory casework and furnishings within Cold Room unless specified herein.
4. Division 21: Fire suppression systems and devices.
5. Division 22: Condenser water supply, return and condensate drain rough-in piping and final connections.
6. Division 22: Service lines to countertop mounted plumbing fixtures including final connections of fixtures.
7. Division 23 Sections for supply and exhaust ductwork; refrigeration tubing, insulation, service roughing-ins, vents; valves, pipes, and fittings; fire-extinguishing systems; and other materials required to complete Cold Room equipment installation.
8. Divisions 26 and 28 Sections for connections to fire alarm systems, wiring, disconnect switches, and other electrical materials required to complete equipment installation.

C. Related Documents:

1. Drawings and general provisions of Contract; including General and Supplementary Conditions and Division Specifications, apply to work of this section.

1.2 QUALIFICATIONS

A. Submit a statement of qualification showing adequate experience in manufacturing equipment of the type and scope called for with a minimum of 10 years experience. The statement of qualifications shall also include a list of a least twenty-five (25) comparable recent projects. Provide an instruction manual for the product the vendor intends to supply for this project.

B. Service and Maintenance: Vendor shall be a manufacturer of Cold Rooms who maintains factory parts and service. An extended warranty service contract shall be tendered at least one month prior to the end of the warranty periods for consideration by the Owner.

C. Standards: The Cold Room design and installation shall conform to applicable codes, ordinances and regulatory requirements governing the use and safety of refrigerants, including, but not necessarily limited to the following:

1. ASHRAE/ANSI Standard 15-70, ARI 520-78, ANSIB9.1-1971 and NFPA-70.
2. UL Listing under Standard 723 as a Class One Building Unit for all insulated panels.
3. Approval by Underwriter's Laboratory (UL), labeled and listed, for all parts and assemblies of the CER.
4. Complete control panel assembly shall be tested and certified by a Nationally Recognized Testing Laboratory (NRTL) to be in accordance with NFPA 70 and UL508A as required by the National Electric Code.

1.3 SUBMITTALS

A. Qualification Data: Prior to executing a contract for the work of this Section, submit qualification data for proposed manufacturer as specified under "Qualification" to demonstrate capabilities and experience. Include list of completed projects, and other information stipulated. Include manufacturer's technical data and specifications in sufficient detail for Owner's Representative and Owner to assess quality and suitability of products proposed.

B. Deviations: Any deviations from the Specifications, including type of finishes as set forth herein, must be listed in detail, separate from the literature furnished with the bid such that the Owner's Representative does not have to expend inordinate time in evaluating competitive bids. In bids, manufacturers should understand that the right is reserved to reject any and all bids. Any bid will rightfully be construed as being based on supplying the design, construction, and materials specified herein.

C. Product Data: For each type of product indicated. Include the following:

1. Manufacturer's Literature and Data.
2. Manufacturer's model number.
3. Cold room plan, room arrangement, including assembly instructions.
4. Condensing units, with mounting rack where required.
5. Evaporator units, with mounting supports, and brackets.
6. Temperature controls and alarms.
7. Diagrams and details of piping, wiring and controls.
8. Controls: Sequence of operation, start-up, shut-down, control data, and schematics
9. Operating Test Data.
10. Maintenance and operating manuals.
11. Options, accessories, and components that will be included for Project.
12. Clearance requirements for access and maintenance.
13. Utility service connections for water, drainage, power, and refrigerant tubing; include roughing-in dimensions.

D. Shop Drawings: For Cold Room and associated equipment. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, anchorage and attachments to other work. Include details of seismic bracing for all equipment.

1. Include on the drawing, the performance requirements for each room.
2. Include service connection information for other trades.

E. Samples. Submit the following material, finish and color samples:

1. Insulated wall panel with exterior and interior finish.
2. Insulated floor panel with exterior and interior finish.
3. Flooring finish.

F. Coordination Drawings:

1. Include plans and elevations;
    a. Clearance requirements for equipment installation.
    b. Access and maintenance.
    c. Details of support for equipment.
    d. Reflected ceiling plan.
    e. Utility service characteristics.
    f. Routing of adjacent utilities, and communications.
    g. Indicate locations of cold room and connections to utilities.

G. Operation and Maintenance Data: Provide operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Product Schedule:
    a. Designation indicated on Drawings.
    b. Manufacturer's name and model number.
    c. List of factory-authorized service agencies including their addresses and telephone numbers.
    d. Warranty: Special warranty specified in this Section.
2. Include instructions for sequential operation, start-up and shut down, with pertinent control data and schematics, room arrangement, and recommended maintenance of equipment. At completion of work, submit one copy of 3-ring binder containing: “as-built” drawings, product data and operation and maintenance information listed above. After Owner’s Representative’s acceptance is received, submit 4 copies for Owner’s use.

H. No portion of the work requiring a shop drawing or sample submission shall be commenced until the submission has been approved by the Owner’s Representative. All such portions of the work shall be in accordance with approved shop drawings and samples.

1.4 QUALITY ASSURANCE

A. UL Certification: Provide electric equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards and that are UL certified for compliance and labeled for intended use.

B. Regulatory Requirements: Install equipment to comply with the following:

1. ASHRAE 15, "Safety Code for Mechanical Refrigeration."

2. NFPA 70, "National Electrical Code."

C. Reference and Standards

1. Air-Conditioning and Refrigeration Institute
   a. (ARI): 420-00 Unit Evaporators for Refrigeration.
   b. 520-97 Positive Displacement Condensing Units.

2. American Society for Testing and Materials (ASTM).
   a. A167-99 Stainless and Heat-Resisting Chromium-Nickel Steel plate, Sheet and Strip.
   b. E84 Surface Burning Characteristics of Building Materials.

D. Acoustics: Indoor, room noise Criteria shall not exceed 45-50 NC.

E. Seismic Restraints: Comply with CBC requirements for seismic zone 4.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Coordination Drawings.

1.6 COORDINATION

A. Coordinate cold room equipment layout and installation with other work, including architectural elements, fire rated shafts and construction assemblies, structural members, framing, ceilings, concrete flooring, lighting fixtures, conduit, laboratory utilities, HVAC ductwork and equipment, rooftop equipment, utility risers and chases, and fire-suppression system components. The Cold Room contractor is responsible for physically measuring the area to assure that their equipment will fit in the designated location. Any dimensional corrections will be accomplished at no change in contract sum.

B. Coordinate location and requirements of utility service connections.

C. Coordinate size, location, and requirements of the following:

1. Overhead equipment supports.

2. Floor depressions.

3. Internal Ramp.

4. Insulated floor system.
5. Insulated walls and ceilings.
6. Fire Rated Assemblies: walls, floors, ceiling.
7. Drains.
8. Evaporators.
9. Condensers.
10. Drains.
11. Ductwork connections.
12. Dry pendant fire sprinkler heads.
13. Fire stopping.
14. Combination fire-smoke dampers if required.
15. Ventilation supply and exhaust ductwork, and controls.
16. Refrigeration tubing and dedicated tubing chase.
17. Maintenance access/path.
18. Alarm and communication connections.

1.7 WARRANTY

A. Provide warranty coverage in accordance with Division 1.

B. Submit warranty signed by Manufacturer and countersigned by Contractor, agreeing to replace / repair / restore defective equipment, components, materials and workmanship during the periods indicated for each item from date of Owner's acceptance. "Defective" is hereby defined to include (but not be limited to) operation or control system failures, performance below required standards, excessive wear, unusual deterioration or aging of materials or finishes, the need for excessive maintenance, and similar unusual, unexpected and unsatisfactory conditions. Prominently display in each room the name of installer/service agency to be contacted during warranty period.

1. Compressor units: five (5) years.
2. Panels or room construction: ten (10) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. R.W. Smith & Company
San Diego, CA
Phone: 858-530-1800,
www.rwsmithco.com

2. BioCold Environmental, Inc.
   Ellisville, MO
   Phone: 636-349-0300
   www.biocold.com

3. Environmental Growth Chambers
   Chagrin Falls, OH
   Phone: 800-321-6854
   www.egc.com

4. Bahnson Environmental Specialties, LLC.
   Raleigh, NC
   Phone: 800-688-5859
   www.eschambers.com

5. Harris Environmental Systems, Inc.
   Andover, MA
   Phone: 978-470-8600
   www.harrisenv.com

2.2 MATERIALS

A. Materials:

1. Galvanized Steel: ASTM A 653/A 653M, G90 coating designation; commercial-quality, cold-rolled steel that is zinc coated by the hot-dip process and chemically treated.

2.3 WALK-IN COLD ROOM CONSTRUCTION

A. General: Prefabricated, sectional, all-metal clad, modular, designed for easy accurate field assembly.

B. Room Dimensions: As indicated on sheet Q6-0.

1. Minimum clear ceiling height of 8’-0” below suspended ceiling.

C. Suspended ceilings: Provide an anodized aluminum with white painted finish exposed tee ceiling grid with an “egg crate” type white plastic panel ½” (12.7mm) thick that has ½” x ½” (12.7mm x 12.7mm) holes covering 90% of the surface area of the panel.

D. Floor Covering: Seamless inlaid sheet vinyl in each environmental room complying with the following:

1. Manufacturer: Medintech by Armstrong or equal.

2. Coving: Seamless corner coving, extending into the sidewalls a minimum height of 4 inches. Coving shall be vinyl capped.

3. Color: As selected by Architect from manufacturer’s full range of colors.

E. Metal Finishes:

1. Inside facing of walls, doors and ceiling, and outside facing of exposed doors, and walls: Smooth-faced aluminum sheet, 0.040 inch thick. Provide close-off panels, with supports, from exposed faces of walk-in to ceiling.
2. Concealed outside facings: Embossed aluminum sheet, 0.040 inch thick, or 26 gauge galvanized steel panel.
3. Interior floor: 16 gauge galvanized steel.
4. 36” high door guards: 1/8” thick aluminum diamond plate for protection against carts.

F. Panel Construction:

1. General: 4 inches thick, precisely formed interior and exterior metal pans, filled with foamed-in-place urethane foam, overall "U" factor 0.03, interchangeable, nominal 1, 2, 3 and 4 foot widths, without wood or metal structural members, quick-lock panel fasteners. Provide special locking wrench and press-fit caps to close wrench holes.
2. Corner panels: 90 degree angle, radiuses 0.5 inch inside and out-side, with 12-inch dimensions each side.
3. Panel edges: Foam-in-place, tongue-and-grooved urethane to assure tight joints. Provide gaskets on the interior and exterior of each panel along every tongue to provide a gasketed seal at each panel joint.
4. Insulation: "Pour-type" urethane, foamed-in-place thermal conductivity (k) not more than 0.12, 97 percent closed cell, flame spread rating 25 or less, when tested in accordance with ASTM E84. Fiberglass, polystyrene or similar materials are not acceptable. Cold Room manufacturer shall supply with their bid a certified statement by issuing agencies that the Cold Room manufacturer has been issued certificates of compliance.
5. Pressure relief port: Provide two-way type ports, to allow for an increase or decrease of air pressure on the interior of the freezer to equalize with air pressure on the exterior. Provide ports with automatically controlled, UL approved anti-sweat heaters. Complete device shall carry Underwriters Label and be assembled ready for connection. Install port in a wall panel away from the direct air stream flowing from the coils.
6. Floor panel strength: Capable of withstanding 600 pounds per square foot uniform load. Floor shall be 2” thick.

G. All Glass Entrance Doors

1. Provide a door gasket of thermoplastic material mounted along both sides and the top of the door. An adjustable rubber double wiper gasket shall be mounted along the door’s bottom edge.
2. Light switch with pilot light mounted on the outside of unit or on control panel.
3. Entrance openings shall be provided in 46” sections. The door shall be an in-fitting flush mounted type. It shall have a “U” channel type, reinforced carbon fiber frame around entire perimeter of the door opening to prevent racking and twisting. Sill plates shall include safety walk strips. Door to be capable of reversing swing, left or right, in the field.
4. Opening size: 36” wide x 78” high.
5. A continuous one-(1) piece extruded aluminum pull shall extend the full height of the door.

6. All Glass Entry Door comprised of sealed triple pane safety glass, with internal heat reflective coating; door shall appear frameless, with face glass across exterior surface. A fiber reinforced internal frame shall support the three-(3) safety glass panes. Exterior glass to be clear to allow a central clear viewing area.
7. The door shall incorporate a totally concealed internal hinge mechanism consisting of an integral torque rod closure device, and utilize a torque mechanism for door adjustment/tension. Exterior visible hinges are not acceptable.
8. Exterior surface of door must be capable of being condensation free when the building temperature and humidity is at +68°F. /60% RH. Door glass shall be covered by manufacturers Ten (10) Year Warranty. Door as manufactured by Anthony Manufacturing Corporation or approved equal.
9. All door panels shall conform to locally recognized electrical and building code.

H. Shelves and Casework: Shall not be furnished with the Cold Rooms. This shall be provided by the casework vendor as described in the stainless steel casework specification. All backing requirements are the responsibility of the vendor to coordinate. Wood backing for shelves and casework is not considered acceptable.

I. Rub rail wall protectors: Manufacturers standard, at floor line of walls exposed to traffic.

J. Entrance Transition Ramps: Shall not be required. Install units in recessed slab to allow level surface transition.

2.4 EVAPORATORS

A. Comply with ARI Standard 420. Units shall be UL listed, forced-ventilation type integral defrosting, internal or external refrigerant distributor, single or multiple fans and motors, drip-pan, deflectors, aluminum or baked-enamel steel housing, hangers, and all accessories.

B. Motors: Refer to “Motors” specification section 23 0513.

C. Coil: Copper Tube, aluminum fins, 8 fins per inch, minimum 4-rows, maximum velocity of 500 fpm.

D. Drain Pans: Heavy gage aluminum. Provide additional drain pans under uncovered refrigerant connections, and interconnect them with main drain pan.

E. If heaters are provided, they shall be integrated into the air flow system. The heaters shall be sized to provide adequate BTU’s of heat for the room design and shall have thermal safeties with a positive shut-off means.

F. A drip pan, drain connection and drain line shall be provided. Unit evaporators shall be equipped with mounting brackets for installation and all controls necessary for safe and satisfactory operation. When the Cold Room is used for freezing, an automatic system for defrosting the unit’s All condensate drain lines inside freezer rooms shall be insulated with ½” insulation. Each refrigerant system shall include a dehydrator, liquid line sight glass, shut-off valve, liquid line solenoid, thermostatic expansion valve at each evaporator, vibration isolator, and other fittings and accessories as required.

G. The entire system shall be cleaned, pressure tested, dehydrated, and separately vacuum tested each time for a period of five hours. The pressure test is to be at least 100 PSI (100kPa) above operating conditions and vacuum at 500 microns (formerly 28.5" of mercury or less. The required operating charge of refrigerant and oil shall then be added and the system tested for performance.

H. Condensate lines shall be routed out of the Cold Room and terminated at condensate drains. Drain Piping: 7/8" O.D., or greater, Type L copper tubing piped from evaporators to open floor drain, rigidly supported at walls 3' O.C. maximum. Adequately pitch piping toward floor drain, carry through wall of refrigerated areas properly trapped and discharged within 2" of floor drain. Provide chrome-plated escutcheons on both sides of wall penetrations. In the event condensate drain termination cannot be achieved by gravity, provide condensate pump.

I. Defrost Provision:

1. Provide electric heater type defroster. Defrost shall occur during compressor off cycle with evaporator fan running.

2.5 VENTILATION

A. General: Where ventilation, supply and exhaust, is indicated, provide a cutout for each in the ceiling of the room. The dimension of the cutout shall be coordinated with the Mechanical Contractor. The location of the supply cutout shall be as close as possible to the inlet of the fan coil unit to minimize the potential for condensation in the room.

2.6 CONTROLS

A. Main Temperature Control

1. Solid state, microprocessor-based, proportional, electronic controller, utilizing precision, platinum resistance thermometer (RTD) for sensing. Incorporate automatic reset and rate functions to compensate for error due to load variations.

2. Operating Temperatures: Adjustable by up-down keypad type indicator buttons, with values displayed by digital panel meter and actual temperature displayed on large, bright digital read out.

3. Provide system capable of setting and reading temperatures to readable accuracy of 1 degree C.

4. Defrost Functions: Controlled by solid-state programmable microprocessor.

5. Thermostat: Self-contained, one per cold room. Thermostat may be mounted on the unit cooler wall with sensor positioned in inlet air to the evaporator. Unit shall be controlled to plus or minus 1 degree Celsius.

B. Control Panel Enclosure

1. Enclose operating controls, instrumentation, functional switches, and control systems in single control panel center mounted at operator eye level.

2. Provide operating modes and functions clearly indicated by pilot lights and legibly identify with permanently engraved legends.

3. Mount functional switches and operational control settings in recessed area of enclosure behind lockable, hinged door for easy access by authorized maintenance personnel.

4. Panels: Power panels shall be welded steel with no visible hinges complying with requirements of NEMA-1. Finish shall be powder coated white.

2.7 ALARMS

A. Alarms: All rooms shall have adjustable high and low alarms for temperature. All alarm items shall have the features and functions described herein.

1. Digital edit and display of alarm setpoint and time delay on touch screen display.

2. Plain English text message to annunciate the occurrence of each alarm. Each alarm message shall be different from all others. Message shall remain on touch screen display until operator acknowledges alarm.

3. Audio annunciation of alarm occurrence by a piezo-electric device providing a warble tone with variable sound level.

4. An adjustable time delay which must elapse before alarm response or annunciation is executed. This shall be used to reduce the occurrence of nuisance alarms and allow alarm setpoints to be closer to the actual room operating condition.

5. Visual indication of alarm by flashing indicator on the touch screen display. Indicator shall appear to alert operator of an alarm condition, and remain visible until all alarms are cleared. Audio silence function shall not affect indicator status.

6. A reset function shall be provided on the touch screen display to allow the operator to immediately clear and reset all alarms.

B. Compressor Alarm: All rooms shall be provided with alarms for compressor failure to operate and short cycle. This alarm shall have all the features described herein for temperature alarms, but shall not require an adjustable setpoint on the touch screen display. Manufacturer shall preset this alarm.

C. Audio Silence: Provide an audio alarm silence feature, activated by the operator on the touch screen display, including all of the functions and features described herein. Regardless of the audio silence method selected, the occurrence of a new alarm condition will cause the audio alarm to sound. Each time the audio alarm sounds, the operator may specify a different silence method or duration. Silence options are as follows:

D. Audio is silenced until the occurrence of the next alarm.

1. Audio is silenced for a period of time specified by the operator at the time the silence button is pressed. The maximum silence time is 60 minutes and is digitally set in one minute increments on the touch screen display.

E. Remote Alarm Relay Contacts: Dry alarm contacts suitable for connection to remote alarm monitors shall transfer upon activation of selected alarms. Control system shall be provided with two SPDT (single pull, double throw) relays that are separately programmable to specify which alarm events will trigger their transfer. Remote alarm contacts shall automatically reset when all alarms are cleared.

2.8 ELECTRICAL AND LIGHTING

A. Lighting: Provide marine vapor-proof LED, for evenly distributed 70 foot candles. Provide exterior switching and pilot light, and top mounted junction box. This switch shall operate all lights in the walk-in cold room. Lighting systems shall be T-8, straight tube, rapid start, a correlated color temperature of 3500°K and a CRI of 85. Lamps shall be designed to pass the Federal TCLP test in effect at the time of manufacture. U-tube lamps shall not be used. The fixtures shall be UL approved and rated to operate at temperatures as low as –10°C. Light fixtures to be surface-mounted to ceiling. All lighting fixtures shall be high output low temperature ballast, moisture proof type units.

B. Light Cycle Timer: A 24 hour on/off cycle timer shall be provided on control panel for cycling interior lighting. Control light operation with the chamber automation controls.

C. Circuits: Provide electrical panel with circuits and spares as required in Division 23.

D. Electrical Outlets: Outlets shall be duplex NEMA watertight receptacles. Outlet circuits shall be 3wire grounded, 15 amp, 115 volt rated. Electrical outlets shall be connected to the emergency power. The color of outlets shall be Red. Provide flush-mounted vapor-proof duplex electrical outlets as shown on room elevation drawings and mounted 45” A.F.F. The 2”x 4 junction box for each outlet shall be foamed into the insulated panel with a ½” EMT conduit from the junction box and extended to the top of the room to allow for electrical connection of the outlet. All conduit shall be hidden within the walls of the room. All wiring and conduit from the outlet to the Cold Room’s central junction box shall be provided by the Cold Room vendor and must comply with local code. Provide seal-off fittings to prevent condensation.

E. Panels: Power panels shall be stainless steel complying with requirements of NEMA 4X.

2.9 MISCELLANEOUS MATERIALS

A. Elastomeric Joint Sealant: ASTM C 920; Type S (single component), Grade NS (nonsag), Class 25, Use NT (nontraffic) related to exposure, and Use M, G, A, or O as applicable to joint substrates indicated.

1. Requirements:
    a. Sealant is certified for compliance with NSF standards for end-use application indicated.
    b. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.

2. Cylindrical Sealant Backing: ASTM C 1330, Type C, closed-cell polyethylene, in diameter larger than joint width.

2.10 WATER-COOLED CONDENSER

A. Water-Cooled Condenser: Mounted above the cold room with adjacent access panel.

B. Shall be provided complete with motor, water cooled condenser, receiver, compressor and all other necessary components mounted in a flexible manner on a common base with vibration isolation equal to Mason Industries SLRS. Compressor shall be semi-hermetic type and shall be designed for continuous operation at the specified evaporating temperature in a 105°F (40°C) ambient temperature. Motor starters and safety disconnects are required; they shall be furnished for installation in an electrical control panel enclosure. Units shall operate on condenser water (chilled water / glycol loop as specified in Division 23). Condenser water pressure drop shall not exceed 5 PSI (34kPa) based on water. Basis of design: Keeprite Model #KXSA010M6-IT3A as shown in the Basis of Design Appendix 9.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble walk-in units and install refrigeration equipment as described in the respective manufacturer's instructions. Make panel joints tight and seal all panel penetrations to prevent condensation or frosting. Provide closed butt and contact joints that do not require filler.

B. To the extent feasible, mount pipe, conduit, and instrumentation on the exterior and pass thru neatly drilled penetrations to the lights or other devices.

C. Seal or otherwise insure that fastenings to rooms do not compromise vapor barriers or insulation. Seal between all piping and sleeves

D. Install refrigerant tubing per Division 23 Specification Section Refrigerant Piping.

E. Install chilled water and controls serving water-cooled condenser.

F. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and requirements of authorities having jurisdiction.

G. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints. H. Connect equipment to utilities.

H. Pressurize and leak test entire system at not less than 100 psig, clean and dehydrate by maintaining a vacuum of 500 microns, or lower, for a 5 hour period. Add required charge or refrigerant, and oil if necessary, and test entire system for performance. Mark each system clearly as to refrigerant type used.

I. Provide filler panels to enclose spaces between tops of rooms and ceiling of surrounding area. Extend filler panels to underside of construction above if necessary.Loose Components: Install electrical components, devices, floor mounted shelving assemblies, and accessories that are not factory mounted.

3.2 CLEANING AND PROTECTING

A. After completing installation of equipment, repair damaged finishes.

B. Clean and adjust equipment as required to produce ready-for-use condition.

C. Protect equipment from damage during remainder of the construction period.

3.3 DEMONSTRATION, START-UP AND TESTING

A. Start-up Temperature Reduction: On start-up, reset the room thermostats daily for a maximum temperature drop 15 degrees F per day down to 37 degrees F.

B. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

C. Measure and record airflow over evaporator coils, and condenser coils.

D. Verify proper operation of condenser capacity control device.

E. Perform test in accordance with the following:

1. Temperature control of +/-1.0°C in Cold Rooms shall be temperature at the sensor and shall be the total variation in the temperature control of the room. It should not be confused with temperature uniformity as noted below.

2. Temperature uniformity of 0.5°C refers to the maximum allowable variation in temperature as measured on a horizontal plane 40” AFF and within 12” of walls throughout the entire room. Uniformity shall be measured by a multipoint strip chart recorder utilizing a minimum of 12 thermo-couples during a continuous 24-hour test period. Gradient from floor to ceiling shall not be more than 2°C.

3. Room shall recover preset operating temperature within 5 minutes after door has been fully opened to 75°F (24°C) ambient temperature for a period of 1 full minute. Repeat door opening operation, as described, 3 times during the 24 hour period, at least 1 hour apart.

4. After completion of installation, each room shall be tested for a minimum of 24 hours at extremes of temperature specified in Schedule of Rooms. Rooms specified to operate over a range of temperatures shall be tested for 24 hours at each of two set points (to be determined) with the second test at the set point designated for operation at acceptance of the unit.

F. Operate each system and record conditions hourly for 10 hours. Submit the following information:

1. Building and System Identification, Contractor, Factory Representative, Date and Time.

2. Compressor nameplate data: Make, model, horsepower, RPM, refrigerant and charge in pounds.

3. Compressor operation: Approximate percentage running time, pressure gage readings, actual amps (starting and running), condenser entering air temperature.

4. Room temperatures and ambient temperatures for Cold Rooms.

5. Defrost and drain functions of unit coolers.

G. Engage a factory-authorized service representative to demonstrate and train University's maintenance personnel to adjust, operate, and maintain equipment. Refer to Division 01 Section "Demonstration and Training."

1. Demonstrate thermostat temperature controls.
2. Demonstrate dry contact high temperature alarm notification functions:
   a. (2) Cold room audible alarm.
   b. (2) Cold room visual alarm.
   c. Silencer switch operation.
   d. Remote annunciation through BMS.
3. Demonstrate condensing unit failure alarm.
4. Demonstrate emergency power operation of the systems, including accessories.
5. Owner's representatives shall be given the option of witnessing and confirming test results. Notify Owner's representative in writing, prior to test.

END OF SECTION 11 5325

SECTION 12 2200 - CURTAINS AND DRAPES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Drapes.
    a. Vivarium Viewing
    b. Laboratory Blackout
2. Drapery tracks.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For the following:

1. Drapery Tracks: Include maximum weights of drapes that can be supported.
2. Fabrics.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit MR 6: For products having rapidly renewable content, documentation showing compliance. Include statement indicating cost for each product having rapidly renewable content.

D. Shop Drawings:

1. Drapery Tracks: Show installation and anchorage details and locations of controls.
    a. Motorized Tracks: Indicate dimensions, weights, and required clearances for track and motor and differentiate between manufacturer-installed and field-installed wiring.
2. Drapes: Show sizes, locations, and details of installation.

E. Samples for Verification: As follows:

1. Drapery Tracks: 18 inches long, with carriers, controls, and accessories.
2. Drapery Fabrics: For each color and pattern indicated, full width by 36 inches long, from dye lot to be used for the Work and with specified textile treatments applied. Show complete pattern repeat if any. Mark top and face of fabric.
3. Drape Fabrication: For each heading, fabric, color, and pattern indicated, a complete full-size panel to verify details of fabrication and thread colors.

F. Product Schedule: For drapes and drapery tracks. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For drapery track installation; reflected ceiling plans drawn to scale and coordinating track installation with openings and ceiling-mounted items, on which the following items are shown:

1. Suspended ceiling components.
2. Structural members to which motors are attached.
3. Size and location of motor access panel.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For products installed to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Drapery Track Carriers: For each size indicated, equal to 5 percent of amount installed, but no fewer than 10 of each size.
2. Drapery Track Controls: For each type indicated, equal to 5 percent of amount installed, but no fewer than 10 of each type.
3. Drapery Fabrics: For each fabric, color, and pattern indicated, from the same product run, full-width lengths equal to 5 percent of amount installed, but no fewer than 10 yards of each fabric, color, and pattern.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: For drapes and drapery tracks, fabricator of drapes.

B. Provide the following upon request:

1. Product Certificates: For each drapery fabric treated with flame retardant, signed by fabric supplier and indicating treatment durability and cleaning procedures required to maintain treatment effectiveness.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before drape fabrication, and indicate measurements on Shop Drawings.

B. Scheduling: Do not deliver or install drapes until after other finish work, including painting, is complete and spaces are otherwise ready for occupancy.

PART 2 - PRODUCTS

2.1 DRAPERY TRACKS

A. Manually Operated Track Insert drawing designation:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Kirsch Window Fashions; a Newell Rubbermaid brand.
   b. Silent Gliss.
   c. Springs Window Fashions; SWFcontract.
2. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches o.c.
   a. Lengths and Configurations: As indicated on Drawings.
   b. Support Capability: Weight of drape indicated mounted on track length indicated.
   c. Finish: Clear anodic coating.
3. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drape plus force applied to operate track.
   a. Mounting Surface: As indicated on Drawings .
   b. Size: Adjustable.
4. Installation Fasteners: Sized to support track assembly and drape, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
5. Operation: Cord tension pulley complying with WCMA A 100.1.
   a. Pulley Mounting Location: Wall.
   b. Draw: One way, stack as indicated on Drawings.
   c. Operating Hardware Location: On stack side.
6. Carriers: Rollers with hooks .
   a. Master Carriers: Butt.
7. End Stops: Manufacturer's standard with track end cap.
8. Pulleys: Heavy duty.

2.2 DRAPES

A. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.

B. Drape :

1. Heading:
   a. Accordion Pleats: 100 percent fullness.
   b. Heading Accessories:
      1) Woven snap tape, 7/8 inch wide, with nickel-plated snaps at 4 inches o.c..
2. Drapery Fabric: See Interior Finish Material Legend on drawings.
3. Textile Treatments: Stain repellent; and flame retardant, polymer type.
4. Lining Fabric:
   a. Lining Type: Blackout.
   b. Textile Treatments: Stain repellent; and flame retardant, polymer type.

C. Hem Weights: Tape type (string weights).Blackout Curtain Fabric:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. PL Systems, 65 Bethpage Rd., Plainview, NY 11803
   b. Aero Shade Co., Inc., Los Angeles CA 90048
2. Fabric Composition: 38% SEF Modacrylic, 30% Saran Flat Monofilament, 26% Viscose Rayon and 6% Polyester. Provide double-vinyl black color laminated back for opacity. Flame-retardant complying with NFPA 701.

2.3 DRAPE FABRICATION

A. Fabricate drapes in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.

1. One-Way-Stacking Drapes: Add 5 inches to overall width for returns.

B. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are unacceptable.

C. Side Hems: Double-turned, 1-1/2-inch- wide hems consisting of three layers of fabric, and blindstitched so that stitches are invisible on face of drape.

D. Bottom Hems: Double-turned, 4-inch- wide hems consisting of three layers of fabric, and weighted and blindstitched so that weights and stitches are invisible on face of drape.

E. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch return of face fabric.

1. Bottom Hem: Blind stitch to drapery fabric.

F. Blackout Curtain Fabrication:

1. Outside vertical edges shall be supplied with "Velcro" quick-seal strips to facilitate "light-trap" overlaps for easy light-tight attachment to walls.

2. Curtain shall be supplied with minimum 11 inch high front and rear light-trap valances. The valances shall be made of the same black-out curtain materials, sewn flat (no fullness) with a sewn-on Velcro strip, and shall be mounted to the curtain track assembly using the "Light-Trap-Interface".

PART 3 - EXECUTION

3.1 DRAPERY TRACK INSTALLATION

A. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

B. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

3.2 DRAPE INSTALLATION

A. Where drapes abut overhead construction, hang drapes so that clearance between headings and overhead construction is 1/4 inch .

B. Where drapes extend to floor, install so that bottom hems clear finished floor by not more than 1 inch and not less than 1/2 inch .

C. Where drapes extend to windowsill, install so that bottom hems hang above sill line and clear sill line by not more than 1/2 inch .

3.3 ADJUSTING

A. After hanging drapes, test and adjust each drapery track to produce unencumbered, smooth operation.

B. Steam and dress down drapes as required to produce crease- and wrinkle-free installation.

C. Remove and replace drapes that are stained or soiled.

END OF SECTION 12 2200

SECTION 12 2413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.
2. Motor-operated roller shades with single double rollers.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."{

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

C. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

E. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Provide the following upon request:

1. Qualification Data: For Installer.
2. Product Certificates: For each type of shadeband material.
3. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Shadebands:

1. Shadeband Material: Light-filtering fabric.

2.2 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

D. Inside Shadebands:

1. Shadeband Material: Light-filtering fabric.

E. Outside Shadebands:

1. Shadeband Material: Light-blocking fabric.

F. Installation Accessories:

1. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.

2. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.

2.3 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:
    a. Individual/Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
3. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
5. Operating Features:
    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
    b. Capable of interface with audiovisual control system.
    c. Capable of accepting input from building automation control system.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Shadebands:
1. Shadeband Material: Light-filtering fabric.

2.4 MOTOR-OPERATED, DOUBLE-ROLLER SHADES

A. Motorized Operating Systems: Provide factory-assembled, shade-operator systems of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:
    a. Individual/Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
3. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.

4. Limit Switches: Adjustable switches, interlocked with motor controls and set to stop shade movement automatically at fully raised and fully lowered positions.
5. Operating Features:
    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
    b. Capable of interface with audiovisual control system.
    c. Capable of accepting input from building automation control system.
    d. Override switch.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shades for service.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

D. Inside Shadebands:
1. Shadeband Material: Light-filtering fabric.

E. Outside Shadebands:
1. Shadeband Material: Light-blocking fabric.

F. Installation Accessories:
1. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
2. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.

2.5 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

2.6 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch . Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch , plus or minus 1/8 inch .

2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION

SECTION 12 3553 – FIXED LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 WORK INCLUDED

A. Furnishing of materials, products, accessories, tools, equipment, services, scaffolding, ladders, transportation, supervision, labor, product protection, and other items that may not be specifically mentioned, but are necessary for the fabrication and installation of laboratory casework.

B. Furnish and install laboratory casework including, but not limited to, work surfaces, adjustable shelves, tables, standards, slotted studs, filler panels, scribes, knee space panels, accessories, casework in environmental rooms, utility space framing, utility space closure panels between base cabinets and at exposed ends of utility spaces, laboratory sinks, cup sinks, cup drains, strainers, overflows and sink outlets with integral or separate pieces, and miscellaneous items of equipment as listed in these specifications and as shown on drawings, including delivery to the building, unpacking, installing, leveling and scribing to walls and floors as required.

C. Furnish and deliver packed in boxes for receipt, handling and installation by others; electrical service fixtures, task lights including fluorescent bulbs, electrical receptacles and switches listed in these specifications and as shown on drawings as part of the laboratory casework. The above-defined items are to be supplied, not attached, and loose in boxes, properly marked for tailgate delivery.

D. Furnish and set in place for final installation and connection by other trades; service fittings where part of the laboratory casework, listed in the specifications or shown on drawings. Tailpieces shall be furnished less couplings required to connect to the trap or drain piping system. Install service fittings “finger-tight”.

E. Furnish and mount plumbing and electrical fixtures on fume hood superstructure.

1.3 RELATED WORK BY OTHER SPECIFICATION SECTIONS

A. Furnishing, installation and connection of “Service Lines” within and/or attached to equipment, slotted studs, partitions, or service tunnels, through, under or along backs of working surfaces as required for “Service Fixtures.”

B. Final installation, tightening and connecting “Service Fixtures” furnished by laboratory casework manufacturer including the pulling of wire and connecting of electrical fixtures in service lines.

C. Receiving, handling, installing and connecting separate laboratory sinks, cup sinks or drains, overflows, sink outlets and tail-pieces furnished by the laboratory casework manufacturer.

D. Furnishing, installing and connecting vents and drain lines.

E. Furnishing, installing, setting and connecting special electrical and plumbing fixtures and piping to meet local codes, even though not specifically called for in specifications and shown on drawings.

F. Furnishing, installing and connecting of ducts from fume hoods to blowers and from blowers to atmosphere.

G. Furnishing, handling and installing fans with motors (blowers).

H. Furnishing, and installation of framing or reinforcements for wall, floors and ceilings to adequately support laboratory equipment and brick, plaster, metal or wood grounds required for proper anchoring of the equipment.

I. Furnishing and installation of pipe hangers.

J. Furnishing and installation of resilient base on walls and fixed laboratory casework after laboratory casework installation is completed.

K. Furnishing in-wall exhaust duct and connection to vented cabinets.

L. Related Sections include the following:

1. Division 01 Section "Sustainable Design Requirements" for additional LEED requirements.
2. Division 06 Section "Miscellaneous Carpentry" for wood blocking for anchoring laboratory casework.
3. Division 06 Section “Interior Architectural Woodwork”.
4. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.
5. Division 09 Section “Gypsum Wallboard Assemblies” for reinforcements in gypsum board partitions for anchoring casework.
6. Division 09 Section "Resilient Base and Accessories" for resilient base applied to metal laboratory casework.
7. Division 11 Section "Laboratory Fume Hoods" for fume hoods.
8. Division 12 Section “Metal Laboratory Casework and Furnishings” for movable lab tables and movable base cabinets.
9. Division 22 and 26 Sections for installation of service fittings specified in this section.
10. Divisions 22 and 26 for connecting service utilities at indicated points. Piping and wiring for service fittings within casework up to point of connection are specified in this Section.

1.4 DEFINITIONS

A. MDF: Medium-density fiberboard is unacceptable material for laboratory casework.

B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.

1. Ends of cabinets, including those installed directly against walls or other cabinets, are defined as "exposed."

C. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cabinets 78 inches or more above floor are defined as "semi-exposed."

D. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive and faced both front and back with hardwood veneers.

F. Service Fixture: Gas, air, and vacuum cocks; hot and cold reagent grade water faucets; remote control valves; electrical receptacles with necessary flush mounting boxes, conduit or pedestals and plates; light fixtures and switches; motor controls, and other items that serve as a functional part of the laboratory equipment.

G. Service Lines: Gas, air, vacuum, hot and cold reagent grade and reference grade water piping, drain lines, fittings, and shut-off valves necessary to carry respective services from the building rough-in at floor or wall through the equipment to the Service Fixture; conduit and conduit fittings, junction boxes, disconnect switches and fuses or circuit breakers necessary to carry electrical power from building rough-in at floor or wall through equipment to Service Fixtures.

H. Standards: Wall-mounted, twin-tracked supports for shelving or cabinets.

I. Slotted Studs: Double-faced, twin tracked framing members acting as a frame spanning between the utility chase and the building wall or work station at the peninsula bench assembly.

J. Laboratory Casework Contractor: The manufacturer and/or manufacturer’s representative furnishing and installing the laboratory casework, equipment, and accessories listed under these specifications, laboratory equipment schedule, and/or shown on drawings.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Laboratory casework and support framing system, including attachments to other work, shall withstand the effects of earthquake motions determined according to California Building Code (CBC).

1.6 SUBMITTALS

A. Refer to submittal section of the General and Supplementary Specifications in Division 1 for requirements and procedures. Fabrication or purchase of any items prior to approval will be at the manufacturer's risk.

B. Product Data: For each type of product indicated.

C. LEED Submittals:

1. Product Data for Credit EQ 4.4:
    a. For composite wood products, indicating that bonding agents contain no urea formaldehyde.
    b. For adhesives used, indicating that products contain no urea formaldehyde.

D. Shop Drawings: For laboratory casework. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate locations of hardware.
2. Indicate locations and types of service fittings.
3. Indicate locations of blocking and reinforcements required for installing laboratory casework.
4. Include details of utility spaces showing supports for conduits and piping.
5. Include details of support framing system.
6. Include details of exposed conduits, if required, for service fittings.
7. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
8. Include coordinated dimensions for laboratory equipment specified in other Sections.

E. Samples for Initial Selection: For factory-applied finishes and other materials requiring color selection.

F. Samples for Verification: For each type of cabinet finish and each type of countertop material indicated, in manufacturer's standard sizes.

G. Samples for Verification: Provide in-place mockup as described in sub section 1.8 below.

H. Stain and Finish Samples for wood Components

1. Stain for casework and miscellaneous items, shall be selected by the Architect. The laboratory casework manufacturer shall furnish stain and finish samples on same material from which the casework and miscellaneous items will be constructed for apporoval before fabrication of casework starts. Samples shall be clearly identified.
2. Stain and finish samples will be retained by University's Representative.

I. Non-Structural Lateral Force Design: Submit detailed seismic anchorage and attachment drawings and calculations provided by a California-licensed Structural Engineer in compliance with the most recent California Building Code. The submittal shall include:

1. Dimensions and location of the center of gravity of the component.
2. Weight assume dint he calculations including contents.
3. Specification of the anchorage to concrete in detail, including section and testing requirements, if any (inspection and testing to be furnished under this section, if required.)
4. Reaction loads to the supporting structure or other component.
5. If a component other than the structure is used for seismic support, the submittal shall show the adequacy of the load path to the structure or otherwise demonstrate compliance with limitations in the contract documents.
6. The submittal will be reviewed by the design professional responsible for this section of the specification to confirm that it is responsive to project specific context and criteria. The adequacy of the primary structure to resist the reaction loads imparted on the primary structure shall be reviewed and approved by the project Structural Engineer.

J. Qualification Data: For qualified manufacturer. Submit a list of at least five projects of comparable installations of similar size and scope.

K. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard and system structural performance specified in "Performance Requirements" Article.

L. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8 and is certified for chain of custody by an FSC-accredited certification body.

B. Installer Qualifications: An authorized representative of the casework manufacturer for installation and maintenance of units required for this project.

C. Source Limitations: Though products may be manufactured by different manufacturers, obtain and install all casework, including work surfaces, sinks, service fittings and accessories, and fume hoods through one source from a single Laboratory Furniture Contractor.

D. Movable Laboratory Bench Systems must be MET Laboratories or Underwriters Laboratories (UL) 61010A-1 approved and listed. Other UL listings may be acceptable as long as the electrical requirements as shown on the drawings are satisfied. UL label shall be attached to the product.

E. Electrical components, Devices and Accessories: Listed and labeled as define in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

F. Pre-installation Conference: Conduct a conference at the Project Site to comply with requirements in Division 1 Section “Project Management and Coordination.

G. Product Standard: Comply with SEFA 8, “Laboratory Furniture-Casework, Shelving and Tables-Recommended Practices”.

H. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered. Refer to Division 01 Section "Product Requirements."

I. Quality Standards: Comply with the following standards:

1. SEFA 1, “Laboratory Fume Hoods”
2. SEFA 2.3, “Scientific Laboratory Furniture and Equipment.”
3. SEFA 3, “Work Surfaces.”
4. SEFA 7, “Laboratory and Hospital Fixtures.”
5. SEFA 8, "Laboratory Furniture - Casework, Shelving and Tables - Recommended
6. Practices."
7. Woodwork Institute Manual of Millwork, 11th edition or American Woodworking
8. Institute, 8th edition (AWI). Includes certification.
9. ASTM A240, Heat Resistant Chromium and Chromium, Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
10. ASTM A312, Seamless and Welded Austenitic Stainless Steel Pipe
11. ASTM D570, Water Adsorption of Plastics
12. ASTM D695, Compressive Properties of Rigid Plastics
13. ASTM D790, Fluctural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
14. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials
15. ASTM A554, Standard Specification for Welded Stainless Steel Mechanical Tubing
16. ASTM A513, Standard Specification for Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing
17. Builders Hardware Manufacturers Association (BHMA)
18. National Electrical Manufacturers Association (NEMA)
19. National Fire Protection Association (NFPA0 30, Flammable Liquid Storage
20. National Fire Protection Assocation (NFPA) 70, Electrical Components, Devices, and Accessories
21. National Particleboard Association (NPA) 8-Voluntary Standard for Formaldehyde Emission from Particleboard

1.8 MOCK-UP

A. Mockups: Construct a Type 1 (in-place) mockup of laboratory casework indicated on the Drawings, or, if not indicated, as directed by University's Representative. Refer to Division 01 Section "Quality Requirements" for additional requirements.

1. Mockup will be used to verify compliance with design intent and confirm procedures prior to completion of utility rough-ins and to serve as the standard of quality for the casework installation.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 EXCEPTIONS TO DRAWINGS AND SPECIFICATIONS

A. All exceptions shall be subject to written approval prior to receipt of bid. If no written communication is received prior to receipt of bid and approval indicated in an addendum, it is assumed that bidder will be in total compliance with specifications and will be held responsible for default or delay, regardless of any statement to the contrary in their written proposal.

B. Deviations to approved submittals without prior written approval from University shall be at risk to contractor/vendor. University Representative shall make final determination of remediation.

1.10 TESTING

A. The laboratory casework manufacturer shall be required to include in their initial submittals, certified test reports indicating compliance of their laboratory casework finish and work top materials with requirements specified for chemical and physical resistance; and confirmation of load performance for movable tables. The material test reports shall be performed by an independent testing agency qualified for testing indicated, as documented according to ASTM E548.

1.11 FIELD MEASUREMENTS

A. It is the laboratory casework manufacturer's responsibility to verify field measurements and that equipment will fit through entryways, corridors, and door openings enabling a smooth flow of equipment to its proper location in the building. Wall-to-wall counter tops are to be installed with maximum ¼" gap.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Casework shall only occur after building is entirely enclosed from exterior elements.

B. Deliver casework only after painting, utility rough-ins and similar operations that could damage, soil or deteriorate casework have been completed in installation areas.

C. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article of this specification sections.

D. Keep finished surfaced covered with polyethylene film or other protective covering during handling and installation.

1.13 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where laboratory casework is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support laboratory casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

2. Verify field measurements and that equipment will fit through entry ways, corridors, and door openings enabling a smooth flow of equipment to its proper location in the building Wall-to-wall countertops to be installed with a maximum 1/4 inch gap.

C. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating laboratory casework without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.14 COORDINATION

A. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

1.15 WARRANTY

A. Special Warranty: Furnish a written warranty that Work performed under this Section to be and remain free from defects as to materials and workmanship for a period of one (1) years from date of acceptance. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the University. Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of laboratory casework that fail in materials or workmanship within specified warranty period. Failure includes:

1. Ruptured, cracked or stained coating.

2. Discoloration or lack of finish integrity.

3. Cracking or peeling of finish.

4. De-lamination of plastic laminate or edge banding.

5. Slippage, shift or failure of attachment to wall, floor or ceiling.

6. Weld or structural failure (visible weld marks).

7. Warping or unloaded deflection of components.
8. Sealant deterioration, shrinkage or failure.
9. Failure of hardware

1.16 EXTRA MATERIALS

A. Furnish complete touchup kit for each type and color of wood laboratory casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.
2. Modular Countertop Units: Two extra units of each length and material installed.

1.17 WOOD PRODUCTS

A. Wood products shall utilize an environmentally friendly, low VOC (under 2 lbs. Per gallon). Finish process, stains and finishes, shall be executed with the use of compression spray equipment capable of providing high-transfer efficiency and low waste generation. Finish material shall meet SEFA 8 chemical testing requirements.

B. Adhesive manufacturer’s product data sheets are to be provided indicating that the adhesive does not contain urea formaldehyde.

C. All plywood cores are required to have no added urea formaldehyde. This means all veneer cores and/or cross banded panels must use PVA glue lines and all composite core binders must be formaldehyde free.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 Articles, subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term “or equal”, comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before the use of an unnamed manufacturer or product.

B. Epoxy Resin Work Surfaces and Sinks: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to the following:

1. Kewaunee Scientific Corporation – Laboratory Division (Statesville, NC)

2. Or Equal

C. The naming of a manufacturer and designation of a product is for the purpose of identifying a basis of design. Other manufacturers capable of producing the same appearance and having the same quality, durability, and performance may be proosed for use on this project subject to approval of the University's Representative, prior to the receipt of bid.

D. Qualified Bidders must submit with their bid evidence of the successful completion of at least five (5) projects using laboratory casework s ystems and furniture of the type specified for this project.

2.2 CASEWORK RELATED MATERIALS

A. Stainless Steel:

1. Work surfaces, sinks, stainless steel accessories, shelves and shelf supports noted on drawings as "Stainless Steel" shall be type 302/304, austenitic chromium nickel stainless steel in accordance with A.I.S.I. specification containing 8% nickel and 18% chromium. Where noted as such, stainless steel components and shelf supports shall be constructed exactly as those fabricated of cold rolled sheet steel and the same gages. Exposed surfaces shall have #4 finish.

2. Work surfaces and sinks noted on drawings as "Type 316 Stainless Steel" shall be similar to type 302/304 except molybdenum is added to improve the general corrosion and pitting resistance.

B. Clear Float Glass: Complying with ASTM C 1036, Type I, Class 1, Quality q3 not less than 3.0mm thick.

C. Clear Tempered Glass: Complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality q3, not less than 3.0mm thick.

D. Clear Laminated Safety Glass: Complying with ASTM C1172, Kind LT, Condition A, Type 1, Class 1 with 2 lites not less than 3.0mm thick with clear, polyvinyl butyl interlayer.

E. Wood Door and Drawer Front Materials:

1. General: Provide materials that are selected and arranged for compatible grain and color. Do not use materials adjacent to one another that are noticeably dissimilar in color, grain, figure, or natural character markings.

2. Wood Species: White maple

3. Adhesives: Do not use adhesives that contain urea formaldehyde.

4. Hardwood Plywood: ANSI/HPVA HP-1, either veneer core or particleboard core, unless otherwise indicated, made without urea formaldehyde with face veneer of species indicated, selected for compatible color and grain. Grade A exposed faces at least 1/50 inch thick, and Grade A crossbands. Provide backs of same species as faces.

a. Face Veneer Cut: Plain sliced.

b. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde. Particleboard to be used with plastic laminate work surfaces and shelves shall be of 45lb. (20.4 kg) density, and balanced. Particleboard shall meet the following requirements. Submit compliance data from the manufacturer prior to fabrication:

1)	Screw-holding, Face	247 lbs.
2)	Screw-holding, Edge	225 lbs.
3)	Modulus of Rupture	2,393 psi
4)	Modulus of Elasticity	398,900 psi
5)	Internal Bond	80 psi
6)	Surface Hardness	500 lbs.

5. Solid Wood: Clear hardwood lumber of species indicated and selected for grain and color compatible with exposed hardwood plywood, selected for compatible grain and color, with moisture content not more than 7 percent.
6. Edgebanding for Wood-Veneered Construction: 1/8” thick, continuous hardwood strip of same species as face veneer.
7. Hardboard shall meet or exceed ANSI/AHA A135.4-2012 Untempered hardboard ¼ inch (6.35mm), SIS, nominal thickness, smooth exposed side.

2.3 WOOD CABINET MATERIALS

A. General:

1. Adhesives: Do not use adhesives that contain urea formaldehyde.
2. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
3. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core, unless otherwise indicated, made without urea formaldehyde.
4. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
5. Hardboard: AHA A135.4, Class 1 Tempered.
6. Edgebanding for Wood-Veneered Construction: Minimum 1/8” thick, continuous hardwood strip of same species as face veneer.

B. Exposed Materials:

1. General: Provide materials that are selected and arranged for compatible grain and color. Do not use materials adjacent to one another that are noticeably dissimilar in color, grain, figure, or natural character markings. No water stains, no sharp contrasts at veneer joints will be accepted.
2. Wood Species: White maple.
3. Stain Colors and Finishes: As selected by the Architect from manufacturer’s full range.

4. Plywood: Hardwood plywood with face veneer of species indicated, selected for compatible color and grain. Grade A exposed faces at least 1/50 inch thick, and Grade J crossbands. Provide backs of same species as faces; Grade A.
   a. Face Veneer Cut: Plain sliced.
5. Solid Wood: Clear hardwood lumber of species indicated and selected for grain and color compatible with exposed hardwood plywood, selected for compatible grain and color.

C. Semi-exposed Materials:
1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects, of any species similar in color and grain to same species as exposed solid wood.
2. Plywood: Hardwood plywood of any species similar in color and grain to same species as exposed plywood. Grade 1 faces and Grade B crossbands. Provide backs of same species as faces.
3. Provide solid wood or hardwood plywood for semi-exposed surfaces unless otherwise indicated.

D. Concealed Materials:
1. Solid Wood: Any species, with no defects affecting strength or utility.
2. Plywood: Hardwood plywood. Provide backs of same species as faces.
3. Particleboard.
4. Hardboard.
5. MDF is prohibited.

2.4 AUXILIARY CABINET MATERIALS

A. Acid Storage-Cabinet Lining: 1/4-inch- thick, polyethylene or polypropylene lining material.

B. Glass for Glazed Doors: Clear laminated tempered glass complying with ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with 2 lites not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.

2.5 COUNTERTOP, SHELF, AND SINK MATERIALS

A. Epoxy: Factory-molded, modified epoxy-resin formulation with smooth, nonspecular finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kewaunee Scientific, Kemresin
   b. Durcon Company (The).
2. Physical Properties:
   a. Compressive Strength: 38,400 psi
   b. Flexural Strength: 14,900 psi
   c. Tensile Strength: 14,000 psi

d. Modulus of Elasticity: Not less than 2,000,000 psi.

e. Hardness (Rockwell M): Not less than110.

f. Water Absorption (24 Hours): 0.008%

g. Heat Distortion Point: 325 degrees F

h. Fore Resistance: Self-Extinguishing

3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.

b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

4. Color: Black.

2.6 WOOD CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kewaunee Scientific Corporation, Laboratory Products Group

2. OC River

3. Mott

4. Or equal.

B. Design: Cabinet construction shall meet AWI or WI, Flush Overlay.

1. Cabinet construction shall meet AWI/WI, Flush Overlay, requirements and specifically meet the following tolerances: The gap between doors, drawers, and pull out boards shall be consistently straight and not exceed 1/8 inch. It is intended that the vertical gap between door, drawer head and pull out boards between adjacent cabinets shall not exceed 1/8 inch. These criteria will require the doors, drawer heads and pull out boards be no further than 1/16 inch from the exterior vertical edge of the cabinet. To achieve these tolerances, the hinge must be countersunk into the door side. Wall cabinets with hinged doors shall meet the same gap tolerances as base cabinets.

2. The top edge of drawers must be no more than 1/8 inch below the top panel of movable cabinets.

3. See subsection 3.2 – Install level, plumb and true using shims as required.

4. Grain Direction: Aligned vertically.

5. Vertical on both doors and drawer fronts, with continuous vertical matching.

6. Lengthwise on face frame members.

7. Vertical on end panels.

8. Side to side on bottoms and tops of units.

9. Vertical on knee-space panels.

10. Horizontal on aprons and table frames.

Where noted as such, provide wall-mounted casework that matches all other laboratory casework in design and material. The assembly must be capable of supporting an equipment load of at least 150lb per running foot above and beyond the weight of the assembly.

C. Sides of all sectional units shall be considered exposed and shall be finished accordingly.

D. Veneer Matching:

1. Veneers on doors, drawer heads, cabinet sides, inside and out, and other exposed surfaces shall be Grade A plain sliced maple with grains vertical. Door and drawer heads within the same cabinet shall be cut and vertically matched from the same sheet of veneer and book matched.

2. Provide veneers for each cabinet from a single flitch, slip and running matched

E. Units, except cabinets with casters or glides, shall have backs with removable panels for access to the pipe spaces at the rear of the units. Removable panels shall be provide in sides of units where units occur in the corners of the rooms and access is required to the pipe spaces. These removable panels shall be designed to permit removable utilizing only a screwdriver through the front of the units and no intermediate rails between drawers are required. Construction: Provide wood-faced laboratory casework of the following minimum construction:

1. Bottoms of Base Cabinets and Tall Cabinets: 3/4-inch- thick hardwood with exposed edge faced with ¼" continuous hardwood strip of same species as exposed providing a flush integral part of the case.

2. Tops and Bottoms of Wall Cabinets and Tops of Tall Cabinets: 1-inch- thick 9-ply veneer-core hardwood plywood with exposed edge faced with 1/8 inch minimum continuous hardwood strip of same species as exposed.

3. Ends of Cabinets: 3/4-inch- thick hardwood plywood with front exposed edges faces with a 1/8 inch minimum continuous hardwood strip of same species as exposed. End panels shall be glued to horizontal frame units and to solid bottom panels. Joint construction shall be blind, not extended to face of cases. Joinery shall be blind mortise and tenon, multiple doweled, interlocking mechanical or stopped tongue and groove

4. Shelves: 3/4-inch thick veneer-core hardwood plywood. Provide hardwood edgebanding on front and back.

5. Base Cabinet Top Frames: ¾-inch-by-2-1/2 inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.

6. Toe spaces shall be nominally 3-inches deep and 4-inches high, fully enclosed and in top.
   a. Horizontal Front and Rear: 2-1/2" x 1" hardwood.
   b. Side: 3/4" x 1-1/2" hardwood.
   c. Intermediate Horizontal Front and Rear: 1-1/2" x 3/4" hardwood (where locks are required or over cupboards).

7. Base Cabinet Stretchers: 3/4-by-4-1/2-inch panel product strips or solid wood boards at front and back of cabinet, glued and pinned or screwed.

8. Backs of Cabinets: 3/4-inch- thick, hardwood plywood where exposed, 1/4-inch- thick hardboard dadoed into sides, bottoms, and tops where not exposed, dadoed into sides, bottoms and tops. Removable backs shall be removable from inside the cabinet with aminimal use of tools. Provide 1 inch x 1 inch cleats, top, bottom, and sides, at the rear corners of the cabinet to fasten the removable panel.

9. Fixed Backs of Movable Cabinets: ¾ inch thick 7-ply veneer faced plywood where exposed, doweled, and rabbeted into end panels.

10. Drawer Fronts: 3/4-inch- thick, hardwood plywood with hardwood faced veneers, edge banded with 1/8 inch solid hardwood. Drawer fronts shall be fastened to the drawer bodies with screws.

11. Drawer Sides and Backs: 1/2-inch-thick, solid hardwood or 9 ply veneer-core hardwood plywood with Baltic birch veneer, with glued dovetail or multiple-dowel joints.

12. Drawer Bottoms: 1/4-inch- thick, veneer core hardwood plywood bottoms glued and dadoed into front, back, and sides of drawers. Use 1/4-inch-thick material for drawers 36 inches wide or greater.

13. Doors 48 Inches High or Less: 3/4 inch thick, with particleboard cores and hardwood face veneers and crossbands.

14. Doors More Than 48 Inches High: 3/4 inch thick, five ply lumber core, and hardwood face veneers and crossbands.

15. Stiles and Rails of Glazed Doors 48 Inches High or Less: 3/4-inch- five ply lumber core with hardwood face veneers and crossbands. Mechanical joint fasteners not permitted. Joints shall be mortise and tenon. Sawing pattern on stiles and rails shall match the veneer cut of panel products.

16. Stiles and Rails of Glazed Doors More Than 48 Inches High: 3/4-inch- thick, solid wood with hardwood face veneers.

2.7 WOOD CABINET FINISH

A. Preparation: Sand lumber and plywood before assembling. Sand edges of doors, drawer fronts, and molded shapes with profile-edge sander. Sand after assembling for uniform smoothness at least equivalent to that produced by 600-grit sanding and without machine marks, cross sanding, or other surface blemishes.

B. Staining: Remove fibers and dust and apply stain to exposed and semi-exposed surfaces as necessary to match approved Samples. Apply stain in a manner that will produce a consistent appearance.

1. Exposed and semi exposed surfaces shall be first coated with a stain or toner to secure the desired color. The color coat shall be thoroughly dried. Wood finish shall consist of two coats of a chemical resistant finish applied and thoroughly dried and cured providing a semi-gloss finish. When a natural finish is required, the color coat is omitted. Stain shall be as selected by the Architect.

2. Concealed Surfaces shall receive a double pass coat of resinous sealer.

3. Stain Color: As selected by University’s Representative from manufacturer's full range.

C. Chemical-Resistant Finish: Apply laboratory casework manufacturer's standard two-coat, chemical-resistant, transparent finish. Sand and wipe clean between coats. Topcoat(s) may be omitted on concealed surfaces.

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.

2.8 HARDWARE

A. General: Provide laboratory casework manufacturer's standard, satin-finish commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Stainless-steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches high or less and 3 for doors more than 48 inches high.

C. Hinged Door and Drawer Pulls: Stainless steel back-mounted pulls. Provide 2 pulls for drawers more than 24 inches wide.

1. Design: Wire pulls.
2. Overall Size: 1 by 4 inches.
3. Fastened to the back with two screws.
4. Drawer and pullout board pulls shall be installed horizontally, door pulls shall be installed vertically. Wall cabinets and floor storage cabinet pulls should be located for reaching convenience and ADA accessibility guidelines.

D. Door Catches: Nylon-roller spring catches. Provide 2 catches on doors more than 48 inches high.

E. Drawer Slides: Shall be self-closing, ball bearing, full extension zinc plated assembly that will allow the drawer body to be completely exposed and physically accessible. Drawer slides shall have an integral stop mechanism to avoid inadvertent removal. Assembly shall be typically rated for 100 lbs. at full extension, dynamic load. Slides shall be Accuride Model 3832-SC, or equal as manufactured by Kewaunee Scientific. Drawer slides for file or bind drawers shall be ball bearing, full extension size plated assembly that will allow the drawer body to be completely exposed and physically accessible. Assembly shall be typically rated for 150 lbs. at full extension, dynamic load. Slide shall be Accuride Model 4034, or equal as manufactured by Kewaunee Scientific.

F. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets. Provide where indicated.

G. Standards: Surface mounted adjustable shelves, shall be mounted to twin-tracked standards. Standards shall be coated with an epoxy powder coating complying with BHMA A156.9 Types B04102 with a nominal cross section of 1-1/2 inch x 1/2 inch (38.1mm x 12.7mm). Acceptable manufacturers shall be Reeve, Fixture Hardware Manufacturing Corporation, and Knape and Vogt. Standards and slotted studs shall have a fully compatible slot pattern. Fasten standards to concrete masonry walls or properly blocked steel studded walls with appropriate flat head screws. Adjustable shelves, wall cabinets and drying racks will be furnished with integral mounting brackets or clips.

H. Slotted Studs: Adjustable shelves, wall cabinets and drying rack boards mounted above peninsula or island benches shall be mounted to a welded double-sided, twin tracked stud assembly. Assembly shall be fabricated of 14 gage, fully welded with welds concealed, steel tube with slots laser cut into uprights and be coated with an epoxy powder coat. Acceptable manufacturers shall be Reeve, Fixture Hardware Manufacturing Corporation, and Knape and Vogt. Slotted studs and standards shall have a fully compatible slot pattern. Adjustable shelves, wall cabinets and drying racks shall be furnished with integral mounting brackets or clips to meet design load.

I. Glazing in doors shall be installed on a foam cushion with the glazing tape installed on sides trimmed below the level of the frame and glazing stops. Glazing stops shall be of the same material and finish as the cabinet door.

J. Locks for Wood Cabinets: Cam type, five-pin tumbler type brass with chrome-plated finish; complying with BHMA A156.11, Type E07281.Locks and lock housings shall be fully concealed within the drawer heads and doors. The lock tongues shall engage the rails or stiles when in locked position. Install theft panels above each drawer or cupboard segment in order to isolate locked section.

1. Provide a minimum of two keys per lock and two master keys.
2. Provide where shown.
3. Keying: Key each lock separately.
4. Master Key System: Key all locks to be operable by master key.

2.9 COUNTERTOPS, SHELVES, AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch, with continuous drip groove on underside 1/2 inch from edge.

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by University’s Representative.

1. Outlets: Provide with strainers and tailpieces, NPS 1-1/2, unless otherwise indicated.
2. Overflows: Provide with stainless-steel strainers and tailpieces. Sinks shall be equipped with an overflow that is connected directly to the tailpiece. Overflow shall consist of an outlet located 2 inches below the sink rim and ½ inch diameter minimum flexible typgon or polypropylene tubing to connect to overflow to tailpiece whichs hal be modified to accept tubing. For ADA Accessible sinks, provide standpipe correctly sized for depth of sink.

3. Provide with stainless-steel strainers and tailpieces. Sinks shall be equipped with an overflow that is connected directly to the tailpiece. For ADA Accessible sinks, provide standpipe correctly sized for depth of sink.

C. Epoxy Countertops and Sinks:

1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and with butt joints assembled with epoxy adhesive and concealed metal splines. Provide work surfaces in maximum lengths as possible to minimize seams.
   a. Countertop Configuration: Flat, 1 inch thick, with beveled edge and corners, and with drip groove and applied backsplash. At fume hoods, tops shall be 1 ¼ inch thick.
   b. Countertop Construction: Uniform throughout full thickness.
   c. Curbs shall be 4 inches high and ¾ inch thick of the same material as the work surfaces and shall be provided at the rear of work surfaces on end returns. Curbs shall be bonded to the surface of the top using epoxy adhesive to form a square joint.The gap betweent he curb and wall is to be sealed with silicone sealant, color matched to the work surface.
   d. Joints between work surfaces shall be smooth, even, square, 1/8 inch wide maximum.
2. Sink Fabrication: Molded in 1 piece with smooth surfaces, radiused corners, and bottom sloped to outlet; 1/2-inch minimum thickness, the same color as the surrounding work surface.
   a. Provide with an outlet, removable polypropylene disc strainers and tailpieces. ADA sink trap covers shall be specified under Division 22.
3. Provide raised (marine) edge around perimeter of countertops at sinks, where indicated; pitch two ways to sink to provide drainage without channeling or grooving.
4. Punch holes for service fittings at factory.
5. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to insure rigidity without deflection.
6. Weld shop-made joints.
7. Where field-made joints are required, provide hairline butt-joints mechanically bolted through continuous channels welded to underside at edges of joined ends. Keep field jointing to a minimum.
8. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
9. Provide sinks for drop-in installation with ¼ thick (6mm) thick lip around perimeter of sink. Top edge of sink shall be positioned 1/8 inch below the work surface with a 30 degree bevel from the top of the work surface to the top of the sink rim.
10. Sink supports: Epoxy sinks mounted in epoxy resin work surfaces shall be supported on steel channels under the sink and compressed by screw type rods to insure a tight fit to the underside of the work surface with a waterproof compound.

11. .Provide with integral rims except where located in stainless-steel countertops.
12. Apply 1/8-inch- thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.
13. Traps furnished under Division 22.

D. Cup Sinks

1. Epoxy 3 by 6 inch oval. Provide with polypropylene strainers and integral tailpieces.

2.10 MOVABLE BASE CABINETS

A. Movable Base Cabinets: Cabinets with casters or otherwise noted shall be constructed as follows:

1. Movable cabinet shall be nominally 34 inches high. The top of the base cabinet shall be plastic laminate (color selected by the Architect) with 3/4 (19mm) wide x 5/32 inch (4 mm) thick edge banding on four sides. Movable cabinets shall have a finished 12 gage metal plate across the full bottom face of the cabinet through which casters shall be attached. Interior bolt heads for casters shall be countersunk.
2. Where noted on the drawings, cabinets with casters shall be constructed without toe spaces. The cabinet shall be constructed with a reinforced base capable of supporting a 4 inch (100mm) high caster assembly in each corner. Casters shall be swivel, locking type on front and fixed type on rear, rated for minimum 250 pounds (113.4 KG) load each. Casters shall be equal to Algood Model S5033-SRG, soft rubber wheeled casters. The entire assembly shall be reinforced to permit mobility without twisting. Casters shall be through-bolted through bottom of cabinet at all four bolts and interior bolt heads shall be countersunk to conceal bolt heads. Allow sufficient clearance between top of cabinet and underside of work surfaces or apron to facilitate movement. Cabinets with casters shall be completely finished including 3mm edge banding on four sides, top and bottom since surfaces are considered exposed. Cabinets shall have a minimum 45 lbs. counterweight in the rear of the cabinet to help prevent tip over of the cabinet.
3. Drawer units must be equipped with a drawer interlock mechanism so that only one drawer in a vertical stack can be opened at one time. Interlock unit shall be integral part of the drawer slide unit equal to Accuride Model 3641 and companion slide Model 3642.

2.11 MECHANICAL SERVICE FITTINGS (PROVIDED BY DIV. 22)

A. Manufacturers. Service fittings shall be manufactured by:

1. Water Saver Corporation
2. Chicago Faucets
3. Broen Faucets
4. Or Equal

B. Mechanical service fixtures shall comply with SEFA 7, “Laboratory and Hospital Fixtures-Recommended Practices. Fixtures for liquids and gaseous mixtures shall have lettered and colored indexes for each service. Handles shall be the four-arm type, with color coded index tabs identifying utility. Serrated hose ends shall have seven (7) serrations. Fixtures for gas, air and vacuum shall be needle valve, large type. Water fixtures shall be compression type. Drain fittings shall be polypropylene unless otherwise noted. Fixtures that serve special gases (N2, O2, etc.) and instrument air shall be lubricated, cleaned, capped protected, and delivered certified for “Oxygen” service.

1. Provide fittings complete with washers, locknuts, nipples and other installation accessories necessary for final connection. Include the deck flanges, escutcheons, handle extension rods and similar items.

C. Materials: Plumbing fixtures, except for drain fixtures and fittings, shall be a forged red-brass composition containing at least 85% copper with washers and seats, of maximum wear resistant materials for the specific use. Reagent grade water fixture to be brass gooseneck type with an internal polypropylene lining that permits recirculation to the manual outlet.

D. Needle Valves (Large): Provide large needle valves with a renewable valve seat and floating cone made of stainless steel or Monel metal with removable serrated outlet.

E. Compression Water Valves: Provide units complying with ASME A112.18.1. Compression water valves shall have a renewable unit containing all working parts, including a stainless steel replaceable seat and valve disc. Unit shall be broached on the outside for permanent position in the valve body. The unit shall contain an integral control device for volume of water discharged by the faucet. The valve shall have a removable serrated hose unless otherwise noted. Valve shall be rated for 125 psi (857 kPa) operating pressure with a max of 190 psi (1303 kPa) for intermittent use.

F. Faucet Accessories: Hot and cold water combination sink faucets shall have aerator tips. Cup sink and reagent grade water faucets to have serrated hose ends. Faucets are to be swivel type except reagent grade water.

G. Industrial Water Sign: 1/8 inch thick black laminated plastic with engraved white letters “INDUSTRIAL WATER DO NOT DRINK”. Provide a sign at all industrial hot and industrial cold water valves. At panel mounted valves mount sign on panel above valve handle and at all gooseneck fixtures provide with 3/8 inch thick split ring mounting bracket.

H. Hand Held Eye Wash: Where indicated with designation “EW” on floor plans, provide a unit that consists of a dual head eye wash assembly, 6 feet (1828.8mm) length of rubber hose, work surface mounting stand, slip ring mechanism to allow for hands free operation and in-line vacuum breaker. Unit’s finish to match other service fittings.

I. Service Identification. Index buttons mounted in fixture handles shall identify the following services. Buttons shall be color-coded and lettered.

	SERVICE	LETTERING	DISC COLOR
1.	Hot Water	HW	Red
2.	Cold Water	CW	Green

3.	Gas	Gas	Blue
4.	Air	Air	Orange
5.	Vacuum	Vac	Yellow
6.	Reagent Grade Water	RO	White
7.	Nitrogen	N2	Brown
8.	Carbon Dioxide	CO2	Pink

J. Service Fixture Finish. Laboratory brass service fixtures shall be ground smooth, coated with polished chromium plated finish with a clear epoxy coating. Fixtures shall receive multiple applications of coating and are baked for polymerization. Units must be assembled before coating and pressure tested before shipment.

K. Fixture Shipment. Fixtures shall be assembled in factory and supplied loose except for fume hood factory mounted fixtures.

2.12 DRYING RACKS

A. Stainless Steel drying racks, as manufactured by Inter Dyne Systems, Inc. (Norton Shores, MI.) or ISEC, Inc shall be furnished with removable rounded-tip white polypropylene pegs.

B. Stainless steel drip trough, 1/4 inch (6mm) diameter drip trough outlet and flexible clear rubber tubing between drip trough outlet and sink (cut as required). Provide anti-splash screen in trough.

C. Drying racks at umbilical shall be furnished with integral clips to attach to standards. Drying rack size and configuration shall be as indicated on the Drawings.

D. Provide continuous silicone sealant at intersection between drying rack and trough.

2.13 ELECTRICAL FIXTURES

A. General: Provide electrical fixtures in accordance with requirements in Division 26, complete with metal enclosure boxes, receptacles, terminals, switches, pilot lights, device plates, accessories and grommets. Cover plates to be stainless steel. Standard receptacles shall be black, receptacles connected to emergency power shall be red.

B. Electrical Raceways: Electrical raceways mounted directly to partitions, reagent shelves or slotted studs will be supplied and installed under Division 26 Electrical.

C. Task Lights. Task lights located at desks and under first shelf shall be [supplied] and [installed] by the casework manufacturer. Provide cutout at rear of desks to facilitate conduit connection to task lighting. Units shall be as follows:

1. ETL Listed LED Fixtures: Unit to be Reed Premier high output unit, as manufactured by Light Corp, Grand Haven, MI. Task lights by other manufacturers must be equal in appearance, light type, and performance (light level and quality at work surface, actuation.)

2. Dimensions: 2” wide by 17” or 30” long. Nominal Dimensions: Fixtures to be manufacturer’s standard lengths in longest possible size as appropriate for shelf length. Daisy chain multiple fixtures on each lab bench or wall elevation.
3. Housing: Clean anodized aluminum.
4. Color: Silver aluminum with white end caps. Power cord shall be black.
5. Cord: Length of cord shall be 9’-0” with 15W power supply. Provide cord management.
6. Unit must include a single touch on/off switch with touch-and-hold dimmer switch, allowing for 100% to 15% intensity. Fixture must include automatic turn off function after 10 hours (±15 minutes)
7. LED rated lifespan: 50,000 hours
8. Color Temperature: 3500K
9. Color Rendering Index: 84
10. Installation: Fixtures shall be mechanically fastened to underside of bottom shelf.

D. Pedestal Outlets. Pedestal outlets shall be provided where noted (E1, E2). They shall be fabricated of cast aluminum, sloped single face or two faces, as indicated, with neoprene gasket under base and with concealed mounting holes in base for attaching to laboratory casework. Provide holes tapped for conduit. and be finished with a brushed finish to match the Electrical Raceway. The “E1” designation indicates that is a double duplex 110v, 20 amp outlet single (Double) face. The “E2” designation indicates that it is a 220v, 20 amp outlet single (Double) face.

E. Receptacles: Comply with NEMA WD 1, NEMA WD6, FS W-596 and UL 498, duplex type, Configuration 5 20R. Casework manufacturer will be responsible for providing appropriate cutout in their equipment to accommodate the outlet.

1. Receptacle Grade: Hospital grade, unless otherwise noted.
2. GFCI Receptacles: Comply with UL 943, Hospital grade.

F. Cover Plates: Provide satin finish, Type 304 stainless steel cover plates with formed, beveled edges.

G. Cover Plate Identification: Use 1/4 inch (6mm) high letters. On stainless steel or chrome- plated metal, stamp or etch plate and fill in letters with black enamel. Provide at the following locations:

1. Receptacles other than standard 120v duplex, grounding type. Indicate voltage and phase.
2. Switches and thermal overload switches. Indicate equipment being controlled.
3. Pilot lights when located remotely from associated equipment or switch, where function is not obvious. Indicate equipment being controlled.
4. Receptacles, switches and other locations indicated.

2.14 WALL MOUNTED CASEWORK

A. Where noted on drawings, provide wall-mounted casework that matches all other laboratory casework in design and material. The assembly's construction however, must be modified to withstand the rigors of being mounted directly to the wall and suspended above the floor, without sagging or effecting the door or drawer operation. The assembly must be capable of supporting an equipment load of at least 150 lb. (68.04kg) per running foot (304.8mm) above and beyond the weight of the assembly.

2.15 WIRE SHELVING

A. Where noted on the Drawings, provide a wire shelving assembly that is 18 inches deep and 74 inches high. The entire assembly, consisting of a series of shelving units, shall be bolted together for overall stability and be installed in accordance with local seismic requirements.

B. Shelving assembly shall consist of five tiers of wire shelving mounted on steel posts; one in each corner of each shelf. Each post shall have a leveling device. Shelves shall be adjustable in 1inch increments.

C. Each four-foot length of shelf shall support up to 400 lbs.

D. Shelving material shall be steel wire with polished chrome finish.

E. Units shall be similar to Super Erecta Shelving as manufactured by InterMetro Wire Corporation (Wilkes Barre, PA.)

2.16 OVERHEAD SERVICE CARRIER

A. Description: Construct of metal framing system components as manufactured by Unistrut Corporation, Elcen, Grinnell Power-Strut, or equal. Unistrut part numbers are referenced.

B. The entire assembly, including diagonal braces, shall be securely and rigidly fastened to structural slab above or to a structural grid where provided.

C. Paint assembly with color selected by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 JOB SITE CONDITIONS

A. Coordinate with the General Contractor to verify that required backing and reinforcements are in place, secure, and accurately located and that project is ready for installation of laboratory casework.

B. Proceed with work when conditions permit Work to be installed in complete accordance with the original design, accepted submittals, and the manufacturer's written instructions.

C. In the event of discrepancy, immediately notify the Architect in writing. Do not proceed with the installation in areas of discrepancy until issues have been resolved.

3.3 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than 2 fasteners per side.

E. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches o.c.

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

G. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.4 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field-made joints.

1. Use concealed clamping devices for field-made joints in plastic-laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.

C. Fastening:

1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.

2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.

3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.

D. Provide required holes and cutouts for service fittings.

E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.

F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
1. Gap between countertop and adjacent wall shall not exceed ¼-inch.

G. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.5 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.3.

B. Drop-in Installation of Epoxy Sinks: Rout groove in countertop to receive sink rim if not prepared in shop. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

3.6 INSTALLATION OF LABORATORY ACCESSORIES

A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions.

B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.7 ADDITIONAL LABORATORY CASEWORK

A. Furnish additional laboratory casework over and above the quantities indicated on the Drawings. All components are to be supplied loose and will be stored in a location to be designated by the University. Include delivery and all handling necessary to satisfy the storage requirements of the University. All components shall be stored with protective packaging and clearly marked for future identification.

3.8 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by University's Representative.

B. Clean work surfaces leaving tops free of grease and streaks. Use no wax or oils.

C. Protect against soiling and deterioration during remainder of construction period.

D. Protect work surfaces and ledges for the remainder of the construction period with ¼ inch corrugated cardboard or equal completely covering the top and securely taped to edges. Mark cardboard in large lettering "No Standing,"

END OF SECTION 12 3553

SECTION 12 3553.13 METAL LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Furnishing of materials, products, accessories, tools, equipment, services, scaffolding, ladders, transportation, supervision, labor, product protection, and other items that may not be specifically mentioned, but are necessary for the fabrication and installation of laboratory casework.

B. Furnish and install laboratory casework including, but not limited to, work surfaces, adjustable shelves, tables, standards, slotted studs, filler panels, scribes, knee space panels, accessories, casework in controlled environment rooms, utility space framing, utility space closure panels between base cabinets and at exposed ends of utility spaces, laboratory sinks, strainers, overflows and sink outlets with integral or separate pieces, and miscellaneous items of equipment as listed in these specifications and as shown on drawings, including delivery to the building, unpacking, installing, leveling and scribing to walls and floors as required.

C. Furnish and deliver packed in boxes for receipt, handling and installation by others; electrical service fixtures, task lights, electrical receptacles and switches listed in these specifications and as shown on drawings as part of the laboratory casework. The above-defined items are to be supplied, not attached, and loose in boxes, properly marked for tailgate delivery.

D. Furnish and set in place for final installation by other trades; service fittings where part of the laboratory casework, listed in the specifications or shown on drawings. Tailpieces shall be furnished less couplings required to connect to the trap or drain piping system. Install service fittings “finger-tight”.

E. Furnish and mount plumbing and electrical fixtures on fume hood superstructure.

1.3 RELATED WORK BY OTHER SPECIFICATION SECTIONS

A. Furnishing, installation and connection of “Service Lines” within and/or attached to equipment, slotted studs, partitions, service tunnels or service turrets, through, under or along backs of working surfaces as required for “Service Fixtures.”

B. Final installation, tightening and connecting “Service Fixtures” furnished by laboratory casework manufacturer including the pulling of wire and connecting of electrical fixtures in service lines.

C. Receiving, handling, installing and connecting separate laboratory sinks, drains, overflows, sink outlets and tail-pieces furnished by the laboratory casework manufacturer.

D. Furnishing, installing and connecting vents and drain lines.

E. Furnishing, installing, setting and connecting special electrical and plumbing fixtures and piping to meet local codes, even though not specifically called for in specifications and shown on drawings.

F. Furnishing, installing and connecting of ducts from fume hoods to blowers and from blowers to atmosphere.

G. Furnishing, handling and installing fans with motors (blowers).

H. Furnishing, and installation of framing or reinforcements for wall, floors and ceilings to adequately support laboratory equipment and brick, plaster, metal or wood grounds required for proper anchoring of the equipment.

I. Furnishing any miscellaneous materials generally classified as maintenance or supply items.

J. Furnishing and installation of pipe hangers.

K. Furnishing and installation of resilient base on walls and fixed laboratory casework after laboratory casework installation is completed.

L. Furnishing in-wall exhaust duct and connection to vented cabinets.

M. Related Sections include the following:

1. Division 1 Section "Sustainable Design Requirements" for additional LEED requirements.
2. Division 6 Section "Miscellaneous Carpentry" for wood blocking for anchoring laboratory casework.
3. Division 6 Section “Interior Architectural Woodwork”.
4. Division 9 Section "Non-Structural Metal Framing" for reinforcements in metal-framed plaster partitions for anchoring laboratory casework.
5. Division 9 Section "Gypsum Wallboard Assemblies" for reinforcements in metal-framed gypsum board partitions for anchoring laboratory casework.
6. Division 9 Section "Resilient Base and Accessories" for resilient base applied to laboratory casework.
7. Division 11 Section "Laboratory Fume Hoods" for fume hoods.
8. Division 12 Section “Fixed Laboratory Casework and Furnishings”.
9. Divisions 22 and 26 Sections for installing service fittings specified in this Section.
10. Divisions 22 and 26 Sections for connecting service utilities at indicated points. Piping and wiring for service fittings within laboratory casework up to point of connection are specified in this Section.

1.4 DEFINITIONS

A. “Laboratory Casework Contractor” is defined as the manufacturer and/or manufacturer’s representative furnishing and installing the laboratory casework, equipment, and accessories listed under these specifications, laboratory equipment schedule and/or shown on drawings.

B. "Service Fixtures" are defined as gas, air, and vacuum valves, hot, cold, reagent grade water faucets, remote control valves, electrical receptacles with necessary flush mounting boxes, conduits or pedestals and plates, light fixtures, light switches and/or motor switches for hoods and other items which serve as a functional part of the equipment.

C. "Service Lines" are defined as gas, air, vacuum, hot, cold, reagent grade and reference grade water piping, drain lines, fittings and shut off valves necessary to carry respective services from building roughing-in floors or walls through equipment to "service fixture".

D. "Service Lines" also include conduit, junction boxes, conduit fitting, wire disconnect switches and fuse or circuit breakers necessary to carry electrical services from building roughing-in outlets in floors or walls through equipment to "service fixtures."

E. "Standards" are wall mounted, twin-tracked shelf supports.

F. "Slotted Studs" are double-faced, twin-tracked studs comprising the frame spanning between the utility chase and the building wall or workstation at peninsula bench assemblies.

G. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets. This also includes tops and bottoms of shelving in open or glass doored units and open wall shelving.

H. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semi-exposed.

I. Concealed Portions of Cabinets: Surfaces nor usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Laboratory casework components and assemblies shall meet local seismic restraint requirements.

1.6 SUBMITTALS

A. Refer to submittal section of the General and Supplementary Specifications in Division 1 for requirements and procedures. Fabrication or purchase of any items prior to approval will be at the manufacturer's risk.

B. Product Data: For each type of product indicated.

C. Samples for Initial Selection:

1. For factory-applied finishes:
    a. Plastic-laminate countertops
    b. Epoxy sinks
    c. Epoxy countertops

d. Phenolic-composite countertops.

2. Samples for Verification:
   a. For each type of finish, including countertop material, in manufacturer's standard sizes, for approval by Architect.
   b. One full-size, finished base cabinet complete with hardware, doors, and drawers
   c. Reviewed samples will be retained by Architect.

D. Shop Drawings: The laboratory casework manufacturer shall furnish shop drawings showing enclosures, cabinets, hardware, and service banks complete with numbers and names of items and details including construction kinds and gages of materials for hood, cabinets, benches and other items necessary to complete the work. In addition, it is the responsibility of the casework manufacturer to flag any deviations in dimension, material, detail, etc. that is not exactly the same as shown on the contract documents. Those deviations not flagged will be considered "not reviewed", even if missed during the approval process and will have to be changed. Provide number of copies of drawings and data sheets in accordance with Division 1 requirements.

1. Indicate locations of blocking and reinforcements required for installing laboratory casework.
2. Indicate locations and types of service fittings, together with associated service supply connection required.
3. Include details of utility spaces showing supports for conduits and piping.
4. Include details of support framing system.
5. Include details of exposed conduits, if required, for service fittings.
6. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
7. Include coordinated dimensions for laboratory equipment specified in other Sections.

E. Non-Structural Lateral Force Design: Submit detailed seismic anchorage and attachment drawings and calculations provided by a California-licensed Structural Engineer. The submittal shall include:

1. Dimensions and location of the center of gravity of the component.
2. Weight assumed in the calculations including contents.
3. Specification of anchorage to concrete in detail, including inspection and testing requirements, if any (inspection and testing to be furnished under this section, if required).
4. Reaction loads to the supporting structure or other component.
5. If a component other than the structure is used for seismic support, the submittal shall show the adequacy of the load path to the structure or otherwise demonstrate compliance with limitations in the contract documents.
6. The submittal will be reviewed by the design professional responsible for this section of the specification to confirm that it is responsive to project specific context and criteria. The adequacy of the primary structure to resist the reaction loads imparted on the primary structure by shall be reviewed and approved by the project Structural Engineer.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of the casework manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Though products may be manufactured by different manufacturers, obtain and install all laboratory casework, including work surfaces, sinks, service fittings and accessories, and fume hoods through one source from a single Laboratory Furniture Contractor.

C. Testing Agency Qualifications: An independent agency qualified for testing indicated, as documented according to ASTM E 548.

D. Movable Laboratory Bench Systems must be MET laboratories or Underwriters Laboratories (UL) 61010A-1approved and listed. Other UL listings may be acceptable as long as the electrical requirements as shown on the drawings are satisfied. UL label shall be attached to the product.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Product Standard: Comply with SEFA 8, "Laboratory Furniture--Casework, Shelving and Tables--Recommended Practices."

G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

H. Quality Standards: Comply with the following standards:

1. SEFA 1, “Laboratory Fume Hoods”
2. SEFA 2.3, “Scientific Laboratory Furniture and Equipment.”
3. SEFA 3, “Work Surfaces.”
4. SEFA 7, “Laboratory and Hospital Fixtures.”
5. SEFA 8, "Laboratory Furniture - Casework, Shelving and Tables - Recommended
6. Practices."
7. Woodwork Institute Manual of Millwork, 11th edition or American Woodworking
8. Institute, 8th edition (AWI). Includes certification.
9. ASTM A240, Heat Resistant Chromium and Chromium, Nickel Stainless Steel Plate, Sheet, and Strip for pressure Vessels
10. ASTM A312, Seamless and Welded Austenitic Stainless Steel Pip
11. ASTM D570, Water Adsorption of Plastics
12. ASTM D695, Compressive Properties of Rigid Plastics
13. ASTM D790, Fluctural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
14. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials

15. ASTM A554, Standard Specification for Welded Stainless Steel Mechanical Tubing
16. ASTM A513, Standard Specification for Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing
17. Builders Hardware Manufacturers Association (BHMA)
18. National Electrical Manufacturers Association (NEMA)
19. National Fire Protection Association (NFPA0 30, Flammable Liquid Storage
20. National Fire Protection Association (NFPA) 70, Electrical Components, Devices, and Accessories
21. National Particleboard Association (NPA) 8-Voluntary Standard for Formaldehyde Emission from Particleboard

1.8 MOCK-UP

A. Laboratory casework manufacturer shall erect a laboratory casework mock-up at the location as indicated on the Drawings. Once selected, the assembly shall be constructed and assembled in accordance with the construction documents. Modifications required to meet this specification shall be incorporated into the overall design of the project without change in contract sum. Mockup shall include ALL laboratory casework components including fume hoods, fixtures and casework to represent a completed laboratory module. Utilities and hoods do not have to be operable.

B. Once installed and approved, the mock-up shall be maintained at the project site during construction as a standard for judging the completed work.

C. Mockup will be used to verify compliance with design intent and confirm procedures prior to completion of utility rough-ins and to serve as the standard of quality for the casework installation.

D. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 EXCEPTIONS TO DRAWINGS AND SPECIFICATION

A. All exceptions shall be subject to written approval prior to receipt of bid. If no written communication is received prior to receipt of bid and approval indicated in an addendum, it is assumed that bidder will be in total compliance with specifications and will be held responsible for default or delay, regardless of any statement to the contrary in their written proposal.

B. Requests for a substitution must be made directly to the Owner’s Representative’s office for consideration no later than fifteen (15) working days prior to bid receipt date.

C. Requests for a substitution following the bid opening will be rejected.

D. Substitutions approved prior to bid date will be handled as an addendum and be sent to all bidders.

E. Deviations to approved submittals without prior written approval from University shall be at risk to contractor/vendor. University Representative shall make final determination of remediation.

1.10 TESTING

A. The laboratory casework manufacturer shall be required to include in their initial submittals, certified test reports indicating compliance of their laboratory casework finish and work top materials with requirements specified for chemical and physical resistance; and confirmation of load performance for movable tables. The material test reports shall be performed by an independent testing agency qualified for testing indicated, as documented according to ASTM E548.

1.11 FIELD MEASUREMENTS

A. It is the laboratory casework manufacturer's responsibility to verify field measurements and that equipment will fit through entryways, corridors and door openings enabling a smooth flow of equipment to its proper location in the building. Wall-to-wall counter tops are to be installed with a maximum ¼" gap.

B. Where casework is indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating the casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver casework only after painting, utility rough-ins and similar operations that could damage, soil or deteriorate casework have been completed in installation areas.

B. Storage: If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article of this specification section.

C. Handling: Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

D. Delivery of casework shall only occur after building is entirely enclosed from exterior elements.

1.13 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.14 COORDINATION

A. Coordinate layout and installation of metal framing and reinforcements in wall assemblies for support of the laboratory casework.

B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment including rough-in locations and requirements.

1.15 WARRANTY

A. Furnish a written warranty that Work performed under this Section to be and remain free from defects as to materials and workmanship for a period of one (1) year from date of acceptance. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner. Defects include, but are not limited to:

1. Ruptured, cracked, or stained coating
2. Discoloration or lack of finish integrity
3. Cracking or peeling of finish
4. De-lamination of components or edge banding
5. Slippage, shift, or failure of attachment to wall, floor, or ceiling
6. Weld or structural failure (visible weld marks)
7. Warping or unloaded deflection of components
8. Sealant deterioration, shrinkage or failure.
9. Failure of hardware

1.16 EXTRA MATERIALS

A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include scratch fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.
2. Modular Countertop Units: Two extra units of each length and material installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Or Equal: Where products are specified by manufacturers name and accompanied by the term “or equal”, comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before the use of an unnamed manufacturer or product.

B. Metal Laboratory Casework, Movable Laboratory Benches and Tables: Subject to compliance with requirements, provide products by one of the following:

1. Kewaunee Scientific Corporation - Laboratory Division
Statesville, NC 28677
(877) 572-6610
www.kewaunee.com

2. Or Equal

C. Epoxy Resin Work Surfaces and Sinks: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Kewaunee Scientific Corporation – Laboratory Division
Statesville, NC 28677
(877) 572-6610
www.kewaunee.com

2. Or Equal

D. The naming of a manufacturer and designation of a product is for the purpose of identifying a basis of design. Other manufacturers capable of producing the same appearance and having the same quality, durability and performance may be proposed for use on this project subject to approval of the Owner's Representative, prior to receipt of bids.

2.2 CASEWORK RELATED MATERIALS

A. Metal: Cold-rolled commercial steel sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.

B. Minimum Metal Thickness:

1. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Items Not Otherwise Indicated: 0.0428 inch. Except for flammable liquid-storage cabinets, bottoms may be 0.0329 inch if reinforced.

2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.0329 inch except 0.0428 inch for back panels and doors of flammable liquid-storage cabinets and for un-reinforced shelves more than 36 inches long.

3. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 0.0528 inch.

4. Drawer Runners, Sink Supports, and Hinge Reinforcements: 0.0677 inch.

5. Leveling and Corner Gussets: 0.0966 inch.

C. Stainless Steel:

1. Work surfaces, sinks, stainless steel accessories, shelves and shelf supports noted on drawings as “Stainless Steel” shall be type 304, austenitic chromium nickel stainless steel in accordance with A.I.S.I. specification containing 8% nickel and 18% chromium. Where noted as such, stainless steel components and shelf supports shall be constructed exactly as those fabricated of cold rolled sheet steel and the same gages. Exposed surfaces shall have #4 satin finish.
2. Work surfaces and sinks noted on drawings as “Type 316 Stainless Steel” shall be similar to type 304 except molybdenum is added to improve the general corrosion and pitting resistance.

D. Clear Float Glass: Complying with ASTM C 1036, Type I, Class 1, Quality q3 not less than 3.0mm thick.

E. Clear Tempered Glass: Complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality q3, not less than 3.0mm thick.

F. Clear Laminated Safety Glass: Complying with ASTM C1172, Kind LT, Condition A, Type 1, Class 1 with 2 lites not less than 3.0mm thick with clear, polyvinyl butyl interlayer.

G. Epoxy Resin- Refer to Section 12 3553 Fixed Laboratory Casework.

2.3 WORK SURFACES AND CURBS

A. Epoxy Resin: Refer to Section 12 3553 Fixed Laboratory Casework.

2.4 ADJUSTABLE SHELVES

A. Adjustable shelves shall be depth as noted on the Drawings.

B. Adjustable shelves shall be mounted to surface type steel standards at wall condition and slotted studs at movable tables and island bench conditions. Adjustable shelves shall be supported by steel shelf brackets not to exceed 42 inches on center. Brackets shall be 11 gage cold rolled steel with epoxy powder coated finish, complying with BHMA A156.9, Types B04102 and B04112. Shelves shall be fastened to brackets with two stainless steel screws per bracket.

C. Adjustable shelves mounted on slotted studs shall be supplied with a continuous 2 inch high band to create a 1 inch high curb at the rear of the shelf. The curb along the back shall be of similar material as the shelf.

D. Exterior adjustable shelves, those not in cabinets, shall be equipped with a 3/8 inch diameter, 2 inch high stainless steel rail at the front of the shelf. Provide ¾” stainless steel turret at mid-span for rail lengths exceeding 24” in nominal length. Turrets shall be fastened to the shelf in a similar manner as wire pulls are fastened to drawers and doors. Stainless steel screws to be accessible from underside of shelf. Press fit rails are not acceptable.

E. Stainless-Steel Shelves: Made not less than 0.050-inch nominal thickness. Fold down front edge 3/4 inch, fold up back edge 3 inches. Provide integral stiffening brackets, formed by folding up ends 3/4 inch.

2.5 CABINET DESIGN

A. Casework shall be fabricated as sectional units, ready for placement in the laboratory as a complete integral rigid unit permitting relocation at any subsequent time. Component parts of the unit shall be manufactured ensuring uniformity, interchangeability and accurate alignment. All base cabinets to have integral enclosed bases.

B. Where noted as such, provide wall-mounted casework that matches all other laboratory casework in design and material. The assembly must be capable of supporting an equipment load of at least 150 lb. per running foot above and beyond the weight of the assembly.

C. Sides of all sectional units shall be considered exposed and shall be finished accordingly.

2.6 CABINET CONSTRUCTION

A. General: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Integrally frame and weld to form a dirt and vermin-resistant enclosure. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch.

B. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at all four sides of door. Fill doors with noncombustible, sound-deadening material.

C. Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Front, sides, and back fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Provide drawers with rubber bumpers, ball-bearing slides, and positive stops to prevent metal-to-metal contact or accidental removal.

D. Adjustable Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.

1. Adjustable shelves shall be depth as noted on the drawings.

2. Adjustable shelves shall be mounted to surface type steel standards (wall condition) or slotted studs (above peninsula benches). Adjustable shelves shall be supported by steel shelf brackets. Brackets shall be cold rolled steel with epoxy powder coated finish, complying with BHMA A156.9, Types B04102 and B04112. Shelves shall be fastened to brackets with two stainless steel screws per bracket.

3. Adjustable shelves mounted on slotted studs shall be supplied with a continuous 2” high band to create a 1” high curb at rear of shelf. The curb along the back shall be of similar material as the shelf.

E. Toe Space: Fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.

F. Utilities: Provide space, cutouts, and holes for pipes, conduits, and fittings in cabinet bodies to accommodate utility services and their support-strut assemblies.

G. Framing below is used to support utility services between back-to-back base cabinets and between base cabinets and walls where utilities are not within walls.

H. Utility-Space Framing: Laboratory casework manufacturer's standard steel framing units consisting of 2 steel slotted channels complying with MFMA-2, not less than 1-5/8 inches (41 mm) square by 0.0966 inch (2.5 mm) thick, and connected together at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch (32-by-6-mm) steel flat bars. Framing units may be made by welding specified channel material into rectangular frames instead of using U-shaped brackets.

I. Base Molding: As specified by Division 9. Provide on fronts and exposed sides of floor-mounted laboratory casework.

J. Filler Strips and Utility-Space Closure Panels: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges.

2.7 MOVABLE BASE CABINETS

A. Movable Base Cabinets: Cabinets with casters or otherwise noted shall be constructed as follows:

1. Movable cabinet shall be nominally 34 inches high. The top of the base cabinet shall be phenolic resin (color selected by the Architect) ¾” thick. Base cabinets shall have a finished 12 gage metal plate across the full bottom face of the cabinet through which casters shall be attached. Interior bolt heads for casters shall be countersunk.

2. Where noted on the drawings, cabinets with casters shall be constructed without toe spaces. The cabinet shall be constructed with a reinforced base capable of supporting a 4 inch high caster assembly in each corner. Casters shall be swivel, locking type on front and fixed type on rear, rated for minimum 250 pounds load each. Casters shall be equal to Algood Model S5033-SRG, soft rubber wheeled casters. The entire assembly shall be reinforced to permit mobility without twisting. Casters shall be through-bolted through bottom of cabinet at all four bolts and interior bolt heads shall be countersunk to conceal bolt heads. Allow sufficient clearance between top of cabinet and underside of work surfaces or apron to facilitate movement. Cabinets shall have a minimum 45 lbs. counterweight in the rear of the cabinet to help prevent tip over of the cabinet.

3. Drawer units must be equipped with a drawer interlock mechanism so that only one drawer in a vertical stack can be opened at one time. Interlock unit shall be integral part of the drawer slide unit equal to Accuride Model 3641 and companion slide Model 3642.

2.8 WALL MOUNTED CASEWORK

A. Where noted as such, provide wall-mounted casework that matches all other laboratory casework in design and material. The assembly’s construction however, must be modified to withstand the rigors of being mounted directly to the wall and suspended above the floor, without sagging or effecting the door or drawer operation. The assembly must be capable of supporting an equipment load of at least 150 lb. per running foot above and beyond the weight of the assembly.

2.9 METAL FINISH

A. Finish casework support structure and other laboratory furnishings.

B. Preparation: Spray clean metal with a heated cleaner / phosphate solution, pretreat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.

C. Application: Electrostatically applied epoxy or urethane powder coat painting process that coats all hidden and exposed surfaces with an acid and abrasion resistant coating. Bake in a controlled high temperature oven to ensure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thicknesses:

1. Exterior and interior surfaces exposed to view: 1.5 mil average and 1.2 mil minimum.
2. Backs of cabinets and other surfaces not exposed to view: 1.0 mil average.
3. Finish drawer bodies in matching or harmonizing color and apply corrosion resistant treatment to selected, concealed interior parts.

D. All steel laboratory products shall utilize a dry powder coat paint process by means of electrostatically spray, providing high-transfer efficiency low waste generation. Any liquid-applied coatings shall not be acceptable. Manufacturer shall supply documentation that waste generated during the painting process, is a solid, nonhazardous material.

E. Pretreatment: Finish process shall incorporate a phosphate conversion coating during the pretreatment/cleaning operation. Electrostatic application of dry powder shall follow. Coated parts shall pass through curing ovens, which shall cause the powder to melt, flow, gel, cure and bond onto the phosphatized steel substrate.

F. Chemically Resistant Finish: Only highly chemically resistant, dry powder coated finishes that passes the SEFA 8 casework specifications for chemical and durability resistance, will be acceptable. Submit a letter from a third-party validator, verifying independent test results, to the Owner’s Representative for approval - at time of bid submittal.

G. Operator Protection: The application is convenient and easily mastered through robotic application plus manual detailing. The painting process is cleanly contained and has no solvent odor and is performed in an air conditioned room.

H. Overspray Powder Paint: Captured and resprayed. Efficiency; 99.99 percent effective in coating usage, reducing waste generation. Utilize a closed collection system for overspray that is not reused. Powder overspray, which cannot escape the facility, is collected in bulk, eliminating the need for daily replacement/disposal of filter media.

I. VOC Emissions: Provide powder paint sprayed and baked with a near zero (0.29 pounds per gallons maximum) VOC (Volatile Organic Compounds) emissions.

J. Off gassing: Provide firm and stable coating after all steel powder coated parts have cooled from the curing ovens. No further emissions or "Off gassing/Decomposition" vapors shall occur at room temperature.

K. Metal Finish Performance Requirements:

1. Abrasion Resistance: Maximum weight loss of 5.5 mg per 100 cycle when tested on a Taber Abrasion Tester Number E40101 with 1000 gm wheel pressure and Calibrase Number CS10 wheel.

2. Hardness: Surface hardness equivalent to 4H or 5H pencil.
3. Humidity Resistance: Withstand 1,000 hour exposure in saturated humidity at 100 degrees Fahrenheit (38 degrees Celsius).
4. Moisture Resistance: No visible effect to surface finish after boiling water trickled over test panel inclined at 45 degrees Fahrenheit for 5 minutes. No visible effect to surface finish following 100 hour continuous application of a water soaked cellulose sponge, maintained in a wet condition throughout the test period.
5. Adhesion: Score finish surface of test panel with razor blade into 100 squares, 1/16 inch by 1/16 inch, cutting completely through the finish but with minimum penetration of the substrate, and brush away particles with soft brush. Minimum 95 squares shall maintain their finish.
6. Salt Spray: Withstand minimum 200 hour salt spray test, conforming to ASTM B117-59 procedure.

L. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions. Cured films shall be unaffected by 2 ft-lbs impact or ½" mandrel bend when supported on 18 gage steel panel and shall have a pencil hardness of 8H to 9H. The finished product shall have a smooth, hard and flexible finish that has superior resistance to abrasion, corrosion and chemical activity. The polymerized film shall resist the action of the following reagents without any effect other than loss of luster or slight discoloration when subjected to a one c.c. puddle test for one hour:

1. Acetic Acid; 1% to glacial
2. Sulfuric Acid; 25%
3. Sulfuric Acid: 50%
4. Sulfuric Acid: 85%
5. Hydrochloric Acid: 10%
6. Hydrochloric Acid: 37%
7. Nitric Acid: 10%
8. Nitric Acid: 25%
9. Nitric Acid: 60%
10. Phosphoric Acid: 85%
11. Perchloric Acid: 60%
12. Formaldehyde: 37%
13. Phenol: 85%
14. Ammonium Hydroxide Concentrate
15. Carbon Tetrachloride
16. Chloroform
17. Acetone
18. Xylol

19. Furfural
20. Sodium Hypochlorite

M. Color: Selection by the Owner's Representative from manufacturer's standard colors.

2.10 SOURCE QUALITY CONTROL TESTING OF EPOXY RESIN WORK SURFACE

A. Test procedure: Apply 5 drops of each reagent to surface and cover with 25 mm watch glass, convex side down; test volatiles using 1 ounce bottle stuffed with saturated cotton. After 24 hour exposure flush surface, clean, rinse and wipe dry.

B. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:

1. No Effect: No detectable change in surface material.
2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
4. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
5. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

C. Test Results: Submit a report of the test results. The results shall be equal to or better than the following:

REAGENT	RATING
1. Hydrochloric Acid, 37 %	Excellent
2. Sulfuric Acid, 33 %	No Effect
3. Sulfuric Acid, 77 %	No Effect
4. Sulfuric Acid, 96 %	Failure
5. Formic Acid, 90 %	Excellent
6. Nitric Acid, 20 %	Excellent
7. Nitric Acid, 30 %	Excellent
8. Nitric Acid, 70 %	Good
9. Hydrofluoric Acid, 48 %	Fair
10. Phosphoric Acid, 85 %	No Effect
11. Chromic Acid, 60 %	Failure
12. Acetic Acid, 98 %	Excellent
13. 3 8 Equal Parts	Excellent
14. Ammonium Hydroxide, 28 %	No Effect
15. Sodium Hydroxide, 10 %	No Effect
16. Sodium Hydroxide, 20 %	No Effect
17. Sodium Hydroxide, 40 %	No Effect
18. Sodium Hydroxide Flake	No Effect
19. Sodium Sulfide	Excellent
20. Zinc Chloride	No Effect

21.	Tincture of Iodine	Excellent
22.	Silver Nitrate	No Effect
23.	Methyl Alcohol	No Effect
24.	Ethyl Alcohol	No Effect
25.	Butyl Alcohol	No Effect
26.	Benzene	Excellent
27.	Xylene	No Effect
28.	Toluene	Excellent
29.	Gasoline	No Effect
30.	Dichloroacetic Acid	Good
31.	Dimethylformamide	Excellent
32.	Ethyl Acetate	No Effect
33.	Amyl Acetate	Excellent
34.	Acetone	Excellent
35.	Chloroform	Excellent
36.	Carbon Tetrachloride	No Effect
37.	Phenol	Excellent
38.	Cresol	Excellent
39.	Formaldehyde	No Effect
40.	Trichlorethylene	Excellent
41.	Ethyl Ether	Excellent
42.	Furfural	Good
43.	Methylene Chloride	Excellent
44.	Monochlorobenzene	Good
45.	Dioxane	Excellent
46.	Methylethyl Ketone	Excellent
47.	Acid Dichromate	Fair
48.	Hydrogen Peroxide	No Effect
49.	Naphthalene	Excellent

2.11 MOVABLE TABLES

A. Moveable tables shall be constructed as indicated on the Drawings.

B. Moveable tables shall have a 1-1/2 inch apron front and 7 inch apron on sides and back. It shall have 2 inch outside diameter painted steel tube and 1-3/4 inch inner painted steel telescoping leg.

C. Levelers: 1-1/2 inch round – 16 NC x 2-1/2 inch long levelers with non-marring floor glides at each leg complete with locking nut.

D. Moveable tables shall have the ability to be adjusted in height from 30 inches to 37 inches in 1 inch increments inclusive of 1 inch thick work surface.

E. Moveable tables shall be installed at height indicated on Drawings. Fixed metal section of leg shall be set at height appropriate for a 30 inch high table top. Coordinate the under-counter clearance with casework and refrigerators.

F. Moveable tables shall be reinforced with a deep welded steel channel frame appropriate for the load bearing requirements. Load capacity of tables shall be 1,000 lb. uniformly loaded and support a 250 lb. concentrated load at mid-space with deflection not to exceed 1/8 inch.

G. Moveable table shall be equipped with an epoxy work surface unless otherwise noted.

2.12 MOVABLE LABORATORY BENCH SYSTEM

A. General

1. Work surface support frame: 11 gage cold rolled steel
2. Finish: Chemical resistant epoxy in color selected by the Owner's Representative from manufacturer's standard selection.
3. Table height, to top of work surface, shall be set at either 30 inches or 37 inches to allow a refrigerator to be installed below. The table shall have a 4 inch solid apron on the sides.

B. Work Surface Table Frame:

1. Nominal table frame dimensions:
   a. Widths and Depths as indicated on the drawings
   b. Adjustable Height: 30 inch to 37 inch AFF including 1 inch thick work surface.
2. Front upright member are 2 inch outside diameter tube and 1-3/4 inch inner telescoping leg steel tubing. Capable of vertical adjustment in one-inch increments. Fasteners to be stainless steel pan head screws.
3. Levelers: 1-1/2 inch round - 16 NC x 2-1/2 inch long levelers with non-marring floor glides at each leg complete with locking nut.
4. Rear corners shall have 2-1/4 inch diameter x 6 inch high 11-gage collar. Front half of the collar shall be welded to the work surface frame with supporting gussets and the back half mechanically fastened to the rear uprights with socket head button cap and bolt.
5. Back stop angle, with full length bumper, shall be located under the work surface frame to position the 24 inch deep mobile base cabinet 1 inch behind the front edge of the work surface.
6. Load Rating: 100 lbs per linear foot of width to maximum of 800 lbs. With 800 lbs of uniformly distributed load applied to an 8 foot wide work surface, the maximum allowable deflection shall be 1/8 inch measured at the front center rail.

C. Rear Frame Support Structure

1. Nominal dimensions:
   a. Width: As indicated on the drawings.
   b. Height: 84 inches
2. Rear upright supports shall be 11 gage tubular steel, 2 inches outside diameter.
3. Levelers: 1-1/2 inch round – 16 NC x 3.5 inch long, model # 23015T56 as distributed by McMaster-Carr Supply Company, New Brunswick, NJ, or equal.

4. Rear frames: All units shall have a center support to accommodate split shelving. Back-to-back tables shall share a common center shelf support that acts as a conduit for piped services, electrical and data.
    a. Specific tables shown on drawings shall have the ability to remove the shelving, with no center support or raceway, to allow users to place deep bench top equipment on the tables without interference at the rear of the unit. These tables shall have power outlets and data on the vertical uprights.
5. Uprights have slots punched on 1 inch increments starting at nominal 55 inch above the floor to the top of the upright.
6. Upper and lower horizontal cross rails shall be 11 gage steel.
7. Lower structural cross rail shall support an integral single-channel raceway.
8. Raceway to have two (2) 20 amp hospital grade duplex receptacles on 42 inch, 48 inch and 60 inch wide units, three (3) 20 amp hospital grade duplex receptacles on 72 inch wide units, and (1) 20 amp duplex receptacle located in the vertical upright under the work surface.
9. Provide GFI receptacles on all benches within 6’ of water source.
10. Frames shall be pre-wired and pre-plumbed in accordance with MET or UL certified requirements.

D. Plumbing Fixtures
1. Maximum of three plumbing services available.
2. Valves shall be straight pattern instrumentation needle valves with serrated hose ends.
3. Plumbing lines shall be 0.25 inch OD x .035 inch wall thickness of 316 stainless steel tubing with quick disconnect attached to the tube with compression fittings at the top of the upright. Each half of the quick disconnect, coupler and nipple shall be valved.
4. The plumbing lines with the quick disconnects are to be arranged so services cannot be intermixed.

E. Electrical, Data and Phone Connections
1. Electrical power services shall have a 20-amp twist lock plug. The NEMA type for the plug shall be as specified in Division 26 and matches the receptacle configuration in the ceiling service panel. Provide an adequate cord length extending from the top of the upright to the ceiling service panel.
2. Data line shall be provided by the University.

F. Shelves
1. As described under article “Adjustable Shelving” within this section, unless modified under this Article.
2. Shelves on moveable tables shall overhang 1 inch behind the face of the vertical tubular support and be notched around the support.
3. Shelf brackets shall be 11-gage cold rolled powder coated steel. Shelf bracket shall be “L” shaped.

G. Task Lights

1. As described in Specification section 12 3553 Fixed Laboratory Casework.

H. Service Line Assembly

1. Tubing: Fre-Thane 95A Durometer Polyurethane tubing as manufactured by Freelin-Wade Co. (McMinnville, Oregon) Tubing shall be 3/8 inch O.D. with a 1/4 inch I.D. rated for 170 psi working pressure. Provide a 316L stainless steel fitting both ends (3/8 inch O.D. compression to 1/4 inch MNPT). Tubing shall be straight type, light gray in color. Manufacturer to provide sleeve for tubing management.

2. Quick-Disconnect Couplers: Keyed, color coded, 316L stainless steel mechanical quick disconnect couplings (sockets and plugs) shall be used to connect between the Ceiling Service Panel and the Moveable Table. Couplers shall connect only with properly keyed mate and be color-coded to identify different key combinations. Each half of the quick disconnect couplers (socket and plug) shall be valved. Socket keyed quick couplers subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following: Staubli (Duncan, South Carolina).

I. Four Leg Adjustable-Height Add-A-Leg Table

1. Nominal table frame dimensions:
   a. Width and depth as indicated on the drawings.
   b. Adjustable Height: 30 inch to 37 inch AFF including 1 inch thick work surface.
2. Work surface table frame shall be able to detach from the rear frame and form a four-leg adjustable height table with the addition of two Add-A-Legs.
3. Add-A-Leg member shall be the same construction and finish as the front upright member.

J. Cord Sleeve Management: Provide cord management sleeve to bundle service drops from the ceiling service panel to the table, Model Nu-Guard G, as manufactured by Delfingen Sofanou (716) 215-0330 or approved equal. Color selected by Owner’s Representative.

2.13 TABLE LIFT MECHANISM

A. Provide one (1) scissor-type lift cart, capable of raising movable tables off floor without marring finish in order to permit height adjustment. Unit shall be capable of operating at both sitting and standing height. Unit shall be fabricated of materials compatible with decontamination procedures involving the use of steam and para-formaldehyde application.

B. Unit shall be equal to R.S. Material Handling, Inc, St. Catherine, Ontario, Canada (905.687.7176) catalog # BX50 or approved equal.

2.14 CEILING SERVICE PANELS

A. The Ceiling Service Panel (CSP) is a rigid mounting surface for laboratory utilities distributed along the centerline of a laboratory bench group. Panels are designed to accommodate standard junction boxes for electrical and data as well as medical grade quick connect fittings for the distribution of specialty gases, compressed air, and vacuum. CSP is designed to fit most suspended t-bar grid ceiling systems and is specified in a 6 inch width. Panel lengths will be as noted on drawings.

B. A CSP is used in conjunction with a steel frame laboratory table which is vertically adjustable. Utilities on the laboratory table connect to the CSP via cables incorporating twist-lock or flexible tubing with quick-disconnect fittings. Overhead utility supply from the CSP allows for flexibility and mobility of laboratory services without the need to penetrate floors and walls.

C. CSP shall be fabricated from 14-gauge cold rolled steel with urethane or epoxy powder coated finish. All four edges of each panel shall be flanged to a depth of 3/4 inch. Flanges shall have a maximum 1/16 inch radius and shall be welded at intersecting corners to improve rigidity. Height of the panel varies with the size of junction boxes and utility fittings attached. Panels shall be fabricated with openings and mounting holes for all junction boxes and utility fittings. Provide a bushing at opening for data cables to eliminate abrasion of data cables on metal edge. Final finish shall be applied after all flanges, openings and holes are fabricated. Color selected by University's Representative.

D. CSP will be detailed in the laboratory construction documents to include various combinations of utilities by group designation (CSP1, CSP2, etc…) to support a number of laboratory types and bench arrangements. All quick disconnect fittings, distribution tubing and gas hoses shall be supplied with the CSP by Division 12. Division 22 shall supply connections to vacuum at the CSP. Electrical receptacles, cables, communication wiring, faceplates and corresponding connections to those devices shall be supplied by Division 26. Data jacks shall be supplied by Division 27. Identify each service at ceiling service panel. All receptacles shall be labeled with the corresponding circuit number. Identify data receptacles both at the table and the ceiling service panel. Submit label sample for approval by University's Representative.

E. Laboratory casework components and assemblies shall meet local seismic restraint requirements.

2.15 HARDWARE AND ACCESSORIES

A. As described in Specification section 12 3553 Fixed Laboratory Casework unless modified herein.

B. Door catches: cam action positive catch. Provide 2 catches on doors more than 48 inches high.

2.16 MECHANICAL SERVICE FITTINGS

A. As described in Specification section 12 3553 Fixed Laboratory Casework.

2.17 SINKS

A. As described in Specification section 12 3553 Fixed Laboratory Casework.

2.18 ELECTRICAL FIXTURES

A. As described in Specification section 12 3553 Fixed Laboratory Casework.

2.19 CONTROLLED ENVIRONMENT ROOM WALL MOUNTED SHELVING

A. Where noted on drawings, provide full height 14 gage heavy duty rolled stainless steel channel type standards capable of mounting brackets for shelves and counter top at full length of the standard. They shall be bolted into blocking located in wall provided by Controlled Environment Room vendor.

B. Shelving shall be 18 gage type 304 stainless steel at depth as noted in drawings and be fabricated with a grid of oblong slots, ¾" x1 ¾" with 2 ½" lateral spacing to promote ventilation. Each shelf shall be supported with two brackets and be fastened to it.

C. Brackets shall be 12 gage type 304 stainless steel.

D. Where stainless steel work surface is indicated on drawings, provide an appropriate set of brackets to support it without movement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 JOB SITE CONDITIONS

A. Coordinate with the General Contractor to verify that required backing and reinforcements are in place, secure, and accurately located and that project is ready for installation of laboratory casework.

B. Proceed with work when conditions permit Work to be installed in complete accordance with the original design, accepted submittals, and the manufacturer's written instructions.

C. In the event of discrepancy, immediately notify the Owner's Representative in writing. Do not proceed with the installation in areas of discrepancy until issues have been resolved.

3.3 INSTALLATION OF CABINETS

A. The assemblies listed below are to be fastened together with devices of adequate strength to support cabinet or shelf fully loaded. Fully loaded is defined as twenty-five (25) pounds per linear foot per shelf for enclosed wall cabinets or open adjustable shelves not inclusive of cabinet, shelf and bracket weight. Securely fasten wall-mounted items to solid supporting material only. Installation to meet seismic requirements:

1. Wall cabinet to wall.
2. Adjustable shelf to wall.
3. Adjustable shelf to slotted stud.

B. Wall Cabinets: Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches o.c. Align similar adjoining doors to a tolerance of 1/16 inch.

C. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

D. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

E. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.4 WORK SURFACE INSTALLATION

A. Work surface lengths shall be fabricated as specified and indicated on the drawings with ends abutting tightly in a hairline joint, single true plane, smooth and level with no raised edges at the joints and with internal supports placed to prevent deflection. All joints are to be sealed with corrosion resistant sealants. Wall-to-wall work surfaces are to be installed with a maximum ¼ inch gap. All back splashes to be sealed at wall surfaces with corrosion resistant sealants.

B. Make field jointing in the same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted submittal drawings. Joints shall be factory prepared requiring no job site processing of top and edge surfaces.

1. Use concealed clamping devices for field joints in plastic-laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.

C. Work surfaces shall be anchored to base cabinets. Secure work surfaces to cabinets/supports with concealed “Z” type angles or equal fastening devices spaced no more than 24 inches on center, with one located within 6 inches of front and back edge. Tighten according to manufacturer’s written instructions to exert a uniform heavy pressure at joints. Where necessary to penetrate work surface with fasteners, countersink exposed heads approximately 1/8 inch and plug hole flush with material equal to work surface in chemical resistance, hardness, and appearance to adjoining surface. Where work surface is intended to be movable, use a clamping device that is removable. Secure epoxy work surfaces to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inch O.C.

D. Provide holes and cutouts as required for equipment and service fittings and fixtures. Verify size of opening with actual size of item to be used, prior to making openings. Form inside corners to a radius of not less than 1/8 inch. After cutting, rout and file cutouts to ensure smooth, crack-free edges. Seal exposed edges after cutting with a chemical resistant sealer recommended by the manufacturer.

E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.

F. Provide scribe moldings for closures at junctures of work surface, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

G. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.5 INSTALLATION OF SINKS

A. Drop-in Installation of Epoxy Sinks: Rout groove in countertop to receive sink rim if not prepared in shop. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

3.6 INSTALLATION OF ACCESSORIES

A. Install accessories according to Shop Drawings and manufacturer's written instructions. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely without excessive bind.

B. Securely fasten adjustable shelving supports and shelves to partition framing, wood blocking, or reinforcements in partitions.

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

3.7 INSTALLATION OF SERVICE FITTINGS

A. Comply with requirements in Divisions 22 and 26 Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring.

B. Install fittings according to Shop Drawings and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings, piping, and conduit to laboratory casework, unless otherwise indicated.

3.8 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Owner’s Representative. Clean units, including wiping out of drawers and cabinet shelves. Clean counter tops per manufacturer’s instructions leaving tops free of grease and streaks.

B. Protect against soiling and deterioration during remainder of construction period. Protect work surfaces during construction period with ¼ inch (6mm) corrugated cardboard or equal completely covering the top and securely taped to underside of work surface at minimum of 48 inches (1200 mm) o.c. Mark cardboard in large lettering “NO STANDING”.

END OF SECTION 123553.13

SECTION 12 3560 - STAINLESS STEEL VIVARIUM CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. All laboratory casework, working surfaces and other items specified herein shown on the drawings shall be furnished, installed and shall be demonstrated to properly perform in accordance with the function specified herein. Provide all necessary fillers, scribes and miscellaneous accessories and hardware to provide a complete installation.

B. Furnish and deliver packed in boxes for receipt, handling and installation by others; electrical service fixtures, task lights, electrical receptacles and switches listed in these specifications and as shown on drawings as part of the laboratory casework. The above-defined items are to be supplied, not attached, and loose in boxes, properly marked for tailgate delivery.

C. Furnish and set in place for final installation by other trades; service fittings where part of the laboratory casework, listed in the specifications or shown on drawings. Tailpieces shall be furnished less couplings required to connect to the trap or drain piping system. Install service fittings “finger-tight”.

D. Furnish and mount plumbing and electrical fixtures on fume hood superstructure.

1.3 RELATED WORK BY OTHER SPECIFICATION SECTIONS

A. Furnishing, installation and connection of “Service Lines” within and/or attached to equipment, slotted studs, partitions, service tunnels or service turrets, through, under or along backs of working surfaces as required for “Service Fixtures.”

B. Final installation, tightening and connecting “Service Fixtures” furnished by laboratory casework manufacturer including the pulling of wire and connecting of electrical fixtures in service lines.

C. Receiving, handling, installing and connecting separate laboratory sinks, drains, overflows, sink outlets and tail-pieces furnished by the laboratory casework manufacturer.

D. Furnishing, installing and connecting vents and drain lines.

E. Furnishing, installing, setting and connecting special electrical and plumbing fixtures and piping to meet local codes, even though not specifically called for in specifications and shown on drawings.

F. Furnishing, handling and installing fans with motors (blowers).

G. Furnishing, and installation of framing or reinforcements for wall, floors and ceilings to adequately support laboratory equipment and brick, plaster, metal or wood grounds required for proper anchoring of the equipment.

H. Furnishing any miscellaneous materials generally classified as maintenance or supply items.

I. Furnishing and installation of pipe hangers.

J. Furnishing and installation of resilient base on walls and fixed laboratory casework after laboratory casework installation is completed.

1.4 SECTION INCLUDES

A. Stainless Steel casework

B. Work surfaces and sinks

C. Movable tables

D. Wire shelving units

E. Adjustable Shelving

1.5 RELATED SECTIONS

A. Section 07 9200: Joint Sealants

B. Division 09: “Non-Structural Metal Framing” for Backing in Walls for Laboratory Casework and Accessory Anchorage

C. Division 09: Resilient Base and Accessories

D. Section 11 5313: Lab Fume Hoods

E. Section12 3553: Fixed Laboratory Casework

F. Section 22 4400: Lab Fittings and Fixtures

G. Division 22: Plumbing

H. Division 23: Mechanical

I. Division 26: Electrical

1.6 DELIVERY, STORAGE AND HANDLING

A. Schedule delivery of casework and equipment so that spaces are sufficiently complete to allow for installation immediately following delivery.

B. Protect finished surfaces from soiling or damage during handling and installation. Cover working surfaces with cardboard. Mark in large lettering "NO STANDING".

1.7 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Laboratory casework components and assemblies shall meet local seismic restraint requirements.

1.8 DEFINITIONS

A. “Laboratory Casework Contractor” is defined as the manufacturer and/or manufacturer’s representative furnishing and installing the laboratory casework, equipment, and accessories listed under these specifications, laboratory equipment schedule and/or shown on drawings.

B. “Service Fixtures” are defined as gas, air, and vacuum valves, hot, cold, reagent grade water faucets, remote control valves, electrical receptacles with necessary flush mounting boxes, conduits or pedestals and plates, light fixtures, light switches and/or motor switches for hoods and other items which serve as a functional part of the equipment.

C. “Service Lines” are defined as gas, air, vacuum, hot, cold, reagent grade and reference grade water piping, drain lines, fittings and shut off valves necessary to carry respective services from building roughing-in floors or walls through equipment to “service fixture”.

D. “Service Lines” also include conduit, junction boxes, conduit fitting, wire disconnect switches and fuse or circuit breakers necessary to carry electrical services from building roughing-in outlets in floors or walls through equipment to “service fixtures.”

E. “Standards” are wall mounted, twin-tracked shelf supports.

F. “Slotted Studs” are double-faced, twin-tracked studs comprising the frame spanning between the utility chase and the building wall or workstation at peninsula bench assemblies.

G. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets. This also includes tops and bottoms of shelving in open or glass doored units and open wall shelving.

H. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semi-exposed.

I. Concealed Portions of Cabinets: Surfaces nor usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.9 REFERENCE STANDARDS

A. Scientific Equipment & Furniture Association (SEFA)

1. SEFA 1 Laboratory Fume Hoods

2. SEFA 2.3 Scientific Laboratory Furniture And Equipment
3. SEFA 3 Work surfaces
4. SEFA 7 Laboratory and Hospital Fixtures
5. SEFA 8 Laboratory Furniture-Casework-Shelving and Tables – Recommended Practices.

B. American Society for Testing and Materials (ASTM)

1. A240-Heat Resistant Chromium and Chromium – Nickel Stainless Steel Plate, Sheet, and Strip for pressure Vessels
2. A312-Seamless and Welded Austenitic Stainless Steel Pipe
3. D570-Water Adsorption of Plastics
4. D695-Compressive Properties of Rigid Plastics
5. D790-Fluctural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
6. E84-Test Method for Surface Burning Characteristics of Building Materials
7. A554 Standard Specification for Welded Stainless Steel Mechanical Tubing
8. A513 Standard Specification for Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

C. Builders Hardware Manufacturers Association (BHMA)

D. National Electrical Manufacturers Association (NEMA)

E. National Fire Protection Association (NFPA) 30 Flammable Liquid Storage

F. National Fire Protection Association (NFPA) 70 Electrical Components, Devices and Accessories.

1.10 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:

1. Windows and doors are installed and the building is secure and weather tight.
2. Ceiling, overhead ductwork, and lighting are installed.
3. All painting is completed and floor finish is installed.
4. Casework and related materials require the interior building temperature not to exceed 80 degrees (F) to avoid undue structural fatigue and damage. Additionally, frequent and/or excessive changes in temperature and/or humidity levels during the course of the material installation, or once materials are installed, must be avoided to prevent damage to equipment.

B. Under no conditions should moisture levels exceed 50% relative humidity.

1.11 SUBMITTALS

A. Refer to submittal section of the General and Supplementary Specifications in Division 1 for requirements and procedures. Fabrication or purchase of any items prior to approval will be at the manufacturer's risk.

B. Product Data: Submit manufacturer's data for each item of vivarium furnishings and equipment. Include component dimensions, configurations, construction details, joint details and attachments. Indicate location, size and service requirement for each utility connection. See Specification Division 1 for additional general requirements.

C. Shop Drawings: Provide 1/2" = 1'0" scale elevations of each individual and battery of casework units showing cross sections, rough-in and anchor placements, tolerances and clearances. Indicate relationship of units to fume hoods, other laboratory equipment, surrounding walls, ceilings, windows, doors and other building components. Provide 1/4" = 1'0" rough-in plan drawings for coordination with trades. Rough-in shall show free area. In addition, it is the responsibility of the casework manufacturer to flag any deviations in dimension, material, detail, etc. that is not exactly the same as shown on the contract documents. Those deviations not flagged will be considered "not reviewed", even if missed during the approval process and will have to be changed. Provide number of copies of drawings and data sheets in accordance with Division 1 requirements.

1. Indicate locations of blocking and reinforcements required for installing laboratory casework.
2. Indicate locations and types of service fittings, together with associated service supply connection required.
3. Include details of utility spaces showing supports for conduits and piping.
4. Include details of support framing system.
5. Include details of exposed conduits, if required, for service fittings.
6. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
7. Include coordinated dimensions for laboratory equipment specified in other Sections.

D. Samples: Contractor shall submit the following samples for approval by The Owner's Representative, prior to fabrication of the specified mock-up:

1. One (1) 24" (600 mm) wide full height base cabinet consisting of one (1) drawer, one (1) door, one (1) cupboard with adjustable half/full depth shelf and related hardware (pulls, hinges, etc.), complete with finish.
2. One (1) 24" (600 mm) long standard, and one (1) end bracket, with specified finish.
3. Adhesives and sealants.
4. Countertop material (one of each specified): 12" x 12" x 1" (300 mm x 300 mm x 25 mm) thick, showing top, marine edge, drip edge, front edge and backsplash construction.

E. Hardware Samples: Provide samples of door and drawer pulls, locks and hinges.

F. Finish Samples: Submit samples of finish. Verify required sample sizes with University Representative.

G. Submit detailed seismic anchorage and attachment drawings and calculations complying with all California Building Code requirements and regulations for seismic restraint. The submittal shall include:

1. Dimensions and location of the center of gravity of the component.
2. Weight assumed in the calculations including contents.
3. Specification of anchorage to concrete in detail, including inspection and testing requirements, if any (inspection and testing to be furnished under this section, if required).
4. Reaction loads to the supporting structure or other component.
5. If a component other than the structure is used for seismic support, the submittal shall show the adequacy of the load path to the structure or otherwise demonstrate compliance with limitations in the contract documents.
6. The submittal will be reviewed by the design professional responsible for this section of the specification to confirm that it is responsive to project specific context and criteria. The adequacy of the primary structure to resist the reaction loads imparted on the primary structure by shall be reviewed and approved by the project Structural Engineer.

1.12 QUALITY ASSURANCE

A. The supplier for work in this section shall use manufacturers with production facilities including all tools, equipment and special machinery necessary for specializing in the fabrication and installation of the type of equipment specified, with skilled personnel, factory trained workmen and an experienced engineering department. Each shall have the demonstrated knowledge, ability and the proven capability to complete an installation of this size and type within the required time limits: Ten years or more experience in manufacture of laboratory casework and equipment of type specified; and ten installations of equal or larger size and requirements within the last five years.

B. Testing Agency Qualifications: An independent agency qualified for testing indicated, as documented according to ASTM E 548.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Product Standard: Comply with SEFA 8, "Laboratory Furniture--Casework, Shelving and Tables--Recommended Practices."

E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.13 WARRANTY

A. Furnish to The owner's representative a written guarantee for work performed under this section against all defects in materials and workmanship, including against warping, twisting, discoloration, delaminating, for one (1) year from date of acceptance.

1.14 TESTING

A. Include in initial submittals, certified test reports indicating compliance of their laboratory casework finish and work top materials with requirements specified for chemical and physical resistance. The material test reports shall be performed by an independent testing agency qualified for testing indicated, as documented according to ASTM E548.

1.15 FIELD MEASUREMENTS

A. Verify field measurements and that equipment will fit through docks, entryways, elevators, corridors and door openings enabling a smooth flow of equipment to its proper location in the building. Wall-to-wall counter tops are to be installed with a maximum 1/4" (6.35 mm) gap.

1.16 DELIVERY, STORAGE AND HANDLING

A. Deliver casework only after painting, utility rough-ins and similar operations that could damage, soil or deteriorate casework have been completed in installation areas. If casework shall be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article of this specification section.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.17 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

C. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating the casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.18 COORDINATION

A. Coordinate layout of metal framing and reinforcements in wall assemblies for support of the casework.

B. Coordinate installation of casework with installation of fume hoods and other laboratory equipment including rough-in locations and requirements.

1.19 EXTRA MATERIALS

A. Furnish complete touch-up kit for each type and finish of the casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish as well as epoxy tops.

B. Furnish 20 pieces of extra casework hardware (pulls, hinges, glides, casters, etc…) which matches products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.20 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal;" , comply with provisions in Division 1, Section 01600, "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kewaunee (Represented by ISEC)
Contact: Bob Bell
Phone: 858.279.9085
Email: RBBell@isecinc.com

B. Or Equal

2.2 DESIGN REQUIREMENT

A. Counter tops, sinks, stainless steel accessories, shelves and shelf supports noted on drawings as "Stainless Steel" shall be type 302/304, austenitic chromium nickel stainless steel in accordance with A.I.S.I. specification containing 8% nickel and 18% chromium. Where noted as such, stainless steel components and shelf supports shall be constructed exactly as those fabricated of cold rolled sheet steel and the same gages. Exposed surfaces shall have # 4 finish.

B. Door and drawer design: Inset flush.

C. Self-supporting units capable of interchangeable use.

D. Flush interiors: Set cupboard bottom flush with front end facers. Surface mounted bottoms and offsets caused by front face frames which interfere with ease of cleaning are not acceptable.

E. All casework components to be stainless steel. No wood or non stainless metal components are acceptable in the casework and related components.

2.3 CABINET CONSTRUCTION

A. Construction and design shall develop maximum strength and rigidity in each sectional unit. Each sectional unit shall be completely fabricated ready for placement in the laboratory casework and equipment assembly and shall be a complete integral rigid unit in itself to permit relocation at any subsequent time. Component parts of the sectional unit shall be die formed insuring uniformity and interchangeability and shall be assembled in jigs for accurate alignment. Joints shall be notched, keyed and overlapped forming interlocking joint construction. Vertical and horizontal members shall be spot welded and shall be both spot welded and arc welded at stress points. The cabinet shall be fabricated in two (2) sections with a removable 6" (152mm) high drawer apron at the top of 36" (914mm) high cabinets except as noted herein.

B. Screws shall not be used in the construction of the unit proper and shall only be used where backs, pans and panels are required to be removable for accessibility. Sectional units to be located on the laboratory floor shall be equipped with leveling devices easily adjustable from within the units, to compensate for unevenness in the laboratory floor. Access to leveling bolts shall be through holes in the cabinet bottoms directly above the leveling bolts. These access holes shall be provided with removable snap-on covers.

C. Base cabinets to be constructed to achieve an industry standard height of 30" or 36" (762mm or 914mm), not including the 1" (25.4mm) counter top, without raising the cabinet off the floor beyond the height required for normal leveling conditions (1" (25.4mm) nominal) and incorporate the full over face design in which the cabinet body is completely concealed.

D. Stainless steel cabinets shall be constructed of type 302/304 stainless steel with joints and seams butt-welded, ground smooth and polished. Exposed surfaces shall have a #4 finish.

2.4 HARDWARE

A. Drawer pulls: Drawer and hinged door pulls shall be 4” stainless steel wire pulls, all horizontal at doors and drawers.

B. Hinges: (1) Heavy duty, exposed 5 knuckle stainless steel hinge attached with stainless steel metal screws. Provide two hinges for doors up to 36" high. Three hinges for doors over 36" high.

C. Elbow catches: Spring type with strike.

D. Drawer suspension: Mechanical slides shall be full extension 100 lb. Drawer bodies less than 3-1/2" high (including pull out boards) to be furnished with full extension 100 lb. zinc plated Accuride 3832 series, or equal.

E. Shelf supports: Single pin stainless steel metal support.

2.5 LOCKS

A. Locks (installed on all cabinet doors, UON) shall be 5-disc tumbler for master key system. Master Key System: Master key system shall have 5-disc tumbler locks with capacity for 225 primary key changes. Master key one level with the potential of 40 different, non-interchangeable master key groups. Keys: Stamped brass available from manufacturer or local locksmith, and supplied in the following quantities unless otherwise specified: 2 for each keyed different lock; 3 for each group keyed alike locks; 2 for master keys for each system. Lock types shall have heavy duty cylinder. Exposed lock nose finish to be dull nickel (satin) plated. Provide locks by National or equal. For cabinets in Procedure Rooms and Surgery room, each individual cabinet shall be keyed the same for all drawers and doors.

2.6 STAINLESS STEEL WORK SURFACE

A. Counter tops and curbs noted on drawings as “Stainless Steel”, (Type 302/304) shall be constructed of 16 gauge (1.6 mm) nominal thickness, stainless steel sheet, ASTM A666. Exposed surfaces shall have # 4 satin finish.

B. Extend top down 1 inch (25 mm) at edges with a 1/2 inch (13 mm) return flange under frame. Apply heavy (2-3 mm) coating of heat-resistant, sound-deadening mastic to undersurface.

C. Form curb coved to and integral with top surface of one piece, without seams or joints. The top of the curb shall be chamfered 45 degrees.

D. Provide raised (marine) edge around perimeter of countertops containing sinks; pitch two ways to sink to provide drainage without channeling or grooving.

E. Reinforce underside of countertop with channels where necessary to insure rigidity without deflection and coat with a sound deadening material where not exposed to view. Cap ends of channels and stiffeners to prevent rodent entry.

F. Tops shall be as long as practical to permit access to the building and room. Where field-made joints are required, provide continuous channels welded to the underside of the counter for reinforcing and aligning the butt-joints.

G. Electrically weld shop and field made joints, and grind and polish surfaces to produce uniform, directionally textured finish, free of cross scratches. When polishing is completed rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.7 STAINLESS STEEL SINKS

A. Material: 16 gauge, Type 304 stainless steel with No. 4 satin finish on all exposed surfaces and edges.

B. Sinks to be integral with adjacent tops. All seams to be welded and ground smooth. Tops shall be adequately reinforced to accept sinks.

C. Sink bowls: Electrically weld stainless steel bowls to opening in top. Grind welds flush and polish to a satin finish to produce an integral unit with invisible joint line. Coat underside of sink bowls with sound dampening material.

D. Joints: Electrically weld all shop joints; grind smooth and polish. Weld all field joints. Make weld without discolorations and grind, polish to blend harmoniously with a No. 4 satin finish.

2.8 STAINLESS-STEEL SHELVES

A. Adjustable shelves shall be depth as noted on the Drawings.

B. Adjustable shelves shall be mounted to surface type stainless steel standards at wall conditions. Adjustable shelves shall be supported by stainless steel shelf brackets not to exceed 42 inches on center. Brackets shall be 11 gage stainless steel. Shelves shall be fastened to brackets with two stainless steel screws per bracket.

C. Exterior adjustable shelves, those not in cabinets, shall be equipped with a 3/8 inch diameter, 2 inch (50 mm) high stainless steel rail at the front of the shelf. Provide ¾" stainless steel turret at mid-span for rail lengths exceeding 24" in nominal length. Turrets shall be fastened to the shelf in a similar manner as wire pulls are fastened to drawers and doors. Stainless steel screws to be accessible from underside of shelf. Press fit rails are not acceptable.

D. Made not less than 0.050 inch (1.3 mm) nominal thickness. Fold down front edge 3/4 inch (19 mm); fold up back edge 3 inches (75 mm). Provide integral stiffening brackets, formed by folding up ends 3/4 inch (19 mm) and welding to upturned back edge. Weld shop made joints, grind smooth and polish.

E. In all vivarium spaces provide closed-cell neoprene between shelf standards and wall for vermin control.

2.9 STAINLESS STEEL CASEWORK REQUIREMENTS

A. General:

1. Where noted on the drawings, cabinets with casters shall be constructed without toe spaces. The cabinet shall be constructed with a reinforced base capable of supporting a 4" high caster assembly in each corner. Casters shall be swivel locking type at front, fixed in rear, and rated for minimum 250 pounds load each. Casters shall be capable of being processed through the cage washing equipment. The entire assembly shall be reinforced to permit mobility without twisting. Height as per Drawings to fit beneath the casework height of 34" including the 1" counter top. Allow sufficient clearance between top of cabinet and underside of countertop or apron to facilitate movement. Cabinets with casters shall be completely finished on four sides, tops and bottoms to prevent vermin access. Cabinets with casters shall not be fabricated with removable backs. Cabinets shall be constructed of type 302/304 stainless steel with joints and seams welded, ground smooth and polished. Exposed surfaces shall have a #4 finish.

2. Stainless steel surfaces to be cleanable without removal of items and with standard cleaning brushes.

2.10 MOVABLE TABLES:

A. Movable tables shall be constructed as indicated on the Drawings.

B. Movable tables shall have a 1.5 inch apron front and 7 inch sides and backs. It shall have a 1 inch by 1 inch tubular stainless steel telescoping legs fitted with a 1-1/2 inch diameter adjustable non-marring floor glides.

C. Levelers: 1-1/2 inch round – 16 NC x 2-1/2 inch long levelers with non'marring floor glides at each leg complete with locking nut.

D. Movable tables shall have the ability to be adjusted in height from 30 inches to 37 inches in 1 inch increments inclusive of 1 inch thick work surface.

E. Movable adjustable tables shall be installed at height indicated on Drawings. Fixed stainless steel section of leg shall be set at height appropriate for a 30" high table top. Coordinate the under-counter clearance with casework and refrigerators.

F. Movable tables shall be reinforced with a deep welded steel channel frame and corner brackets appropriate for the load bearing requirements. Load capacity of tables shall be 1,000 lb. (453.6kg) uniformly loaded and support a 250 lb. (113.4kg) concentrated load at mid-space with deflection not to exceed 1/8" (3.18mm).

G. Movable table shall be equipped with stainless steel top in vivarium unless otherwise noted.

2.11 WIRE SHELVING UNITS

A. Where noted on drawings, provide a wire shelving assembly that is 18" deep and 74" high. The entire assembly, consisting of a series of shelving units, shall be bolted together for overall stability and be installed in accordance with local seismic requirements.

B. Shelving assembly shall consist of five tiers of wire shelving mounted on steel posts; one in each corner of each shelf. Each post shall have a leveling device. Shelves shall be adjustable in 1" increments.

C. Each 4'-0" length of shelf shall support up to 400 lbs.

D. Shelving material shall be steel wire with polished chrome finish.

E. Units shall be similar to Super Erecta Shelving as manufactured by InterMetro Wire

2.12 MECHANICAL SERVICE FIXTURES

A. Refer to 12 3553 Fixed Laboratory Casework Specification

2.13 ELECTRICAL FIXTURES

A. Refer to 12 3553 Fixed Laboratory Casework Specification

PART 3 – EXECUTION

3.1 JOB SITE CONDITIONS

A. Verify that required backing and reinforcements are in place, secure, and accurately located and that project is ready for installation of laboratory casework.

B. Proceed with work when conditions permit work to be installed in complete accordance with the original design, accepted submittals, and the manufacturer's written instructions.

C. In the event of discrepancy, immediately notify The Owner's Representative in writing. Do not proceed with the installation in areas of discrepancy until issues have been resolved.

3.2 INSTALLATION

A. Set casework components plumb, square, and straight with no distortion and securely anchored. Shim as required using concealed phenolic resin shims and or leveling bolts.

B. Screw continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1/16" tolerance.

C. Secure wall cabinets to solid supporting backing material, not to plaster, lath or gypsum board.

D. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

E. Accessory Installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.

F. Seal all joints where dissimilar materials meet with Sanitary Sealant.

G. Prevention of vermin infestation: Close ends of all tube components; cover or seal holes; seal all metal seams; on fixed and mobile cabinets on all sides, seal cabinet perimeter to wall.

H. Base Cabinet Casework shall be located in their designated positions, leveled, and plumbed true and straight by means of the micro-adjustment device located in each bottom corner of the cabinet. Adjust top rails and sub-tops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to utility space framing, partition framing, blocking or reinforcements in partitions with fasteners spaced not more than 24 inches (600 mm) o.c. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

I. Counter top lengths shall be fabricated as specified and indicated on the drawings with ends abutting tightly, and sealed with corrosion resistant sealants. The horizontal surface shall be smooth and level with no raised edges at the joints. Tops shall be anchored to base cabinets.

J. Install miscellaneous filler panels and scribe as required for a continuous tight and accurate fitting installation with fasteners concealed where practical, without gaps or spaces between cabinetwork or counters and adjoining surfaces. All back splashes to be sealed at wall surfaces with corrosion resistant sealants.

K. Assemblies are to be fastened together with devices of adequate strength to support cabinet or shelf fully loaded. Fully loaded will be defined as twenty-five (25) pounds per linear foot per shelf for enclosed wall cabinets or open adjustable shelves not inclusive of cabinet, shelf and bracket weight. Securely fasten wall-mounted items to solid supporting material only. Installation to meet local seismic requirements.

L. Wall Cabinets: Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, partition framing, blocking or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches (600 mm) o.c. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

M. Utility Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

N. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

O. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate joints only where shown on Shop Drawings.

3.3 INSTALLATION OF ACCESSORIES

A. Install in accordance with manufacturer’s directions. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely without excessive bind.

B. Securely fasten adjustable shelving supports, shelves and pegboards to partition framing, blocking or reinforcements in partitions.

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

3.4 ADJUSTING

A. Repair or remove and replace defective work, as directed by University's Representative upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.5 CLEANING

A. Clean shop finished casework, work surfaces, and accessories; touch up as required, wipe down and broom clean interior and exterior of equipment.

3.6 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent exposure of casework and equipment from exposure to other construction activity during installation.

B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION 12 3560

SECTION 12 3623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes plastic-laminate countertops.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For each type of productpanel products high-pressure decorative laminate.

C. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material.
    a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
    b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
5. Product Data for Credit IEQ 4.1: For installation adhesives, including printed statement of VOC content.

6. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
7. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.
8. Laboratory Test Reports for Credit IEQ 4.4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show locations and sizes of cutouts and holes for plumbing fixtures electrical switches and outlets and other items installed in plastic-laminate countertops.
2. Apply WI Certified Compliance Program label to Shop Drawings.

E. Samples for Verification:
1. Plastic laminates, 12 by 12 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.

B. Installer Qualifications: Licensee of WI's Certified Compliance Program.

C. Provide the following upon request:
1. Qualification Data: For fabricator.
2. Product Certificates: For each type of product.
3. Woodwork Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver countertops until painting and similar operations that could damage countertops have been completed in installation areas. If countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

A. See Interior Finish Material Legend on drawings.

B. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

1. Provide labels and certificates from WI certification program indicating that countertops, including installation, comply with requirements of grades specified.

2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

C. Grade: Custom.

D. Certified Wood: Plastic-laminate countertops shall be made from wood products certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

E. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS .

F. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP, and as follows:

G. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by manufacturer's designations.

H. Edge Treatment: 3-mm PVC edging.

I. Core Material: Particleboard or medium-density fiberboard.

J. Core Material at Sinks: exterior-grade plywood.

K. Core Thickness: 3/4 inch.

1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

L. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2. Medium-Density Fiberboard: ANSI A208.2, Grade 130 , made with binder containing no urea formaldehyde.

3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

4. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

A. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Structural Wood Member Adhesive: 140 g/L.
4. Architectural Sealants: 250 g/L.

2.5 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 12 3661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

1.3 ACTION SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data: For countertop materials.

C. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

E. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size solid surface material countertop, with front edge and backsplash, 8 by 10 inches , of construction and in configuration specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

C. Provide the following upon request:

1. Qualification Data: For fabricator.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. See Interior Finish Material Legend on drawings.

B. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Type: Provide Standard type unless Special Purpose type is indicated.

2. Colors and Patterns: As selected by Architect from manufacturer's full range.

C. Particleboard: ANSI A208.1, Grade M-2.

D. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 1/2-inch- thick, solid surface material.

D. Backsplashes: 1/2-inch- thick, solid surface material.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
   a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

I. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION

SECTION 12 4813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Floor mats EM-1 and EM-2.
2. Recessed frames.

1.3 COORDINATION

A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

B. Shop Drawings:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.
2. Frame Members: Sample of each type and color.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

1. Uniform floor load of 300 lbf/sq. ft..
2. Wheel load of 350 lb per wheel.

B. Regulatory Requirements: Comply with applicable provisions in the 2010 ADA Standards and CBC 11B.

2.2 RESILIENT ENTRANCE MATS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. C/S Group. Floormations
2. Mats Inc. Chicago Collection

B. EM-2: Recessed walk off mats.

1. Color: As selected by Architect from full range of industry colors.
2. Mat Size: As indicated.

2.3 CERAMIC-TILE ENTRANCE MATS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Construction Specialties, Floorometry

B. EM-1: Ceramic Tiles: Large format porcelain tile infill.

1. Daltile Portfolio, colors as scheduled.
2. Tile Size: As indicated.

2.4 FRAMES

A. Recessed Frames: Manufacturer's standard extrusion.

1. Extruded Aluminum: ASTM B 221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
   a. Color: Mill finish .

2.5 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.

1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

C. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

2.6 ALUMINUM FINISHES

A. Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

1. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.

2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION

SECTION 12 9300

SITE FURNITURE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bike Racks
2. Trash Receptacles
3. Recycling Receptacles
4. Security Phones.
5. Bollards.
6. As indicated on the drawing schedule [A-00].

B. Related Sections:

1. Section 32 13 16: Decorative Concrete.
2. Section 32 14 13: Unit Pavers.

1.2 REFERENCES

A. ASTM — ASTM International:

1. C 881 — Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
2. D 1557 — Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
3. F 593 — Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. F 594 — Specification for Stainless Steel Nuts.

1.3 DEFINITIONS

A. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

B. Excessive Compaction: Planting area soil compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

C. Landscape Architect: Landscape Architect employed by the Owner to provide professional landscape architectural services for the Project.

1.4 SUBMITTALS

A. General Requirements: Refer to Division 1.

B. Product Data:

1. For all items specified.

C. Shop Drawings: For all items specified showing elevations, plans details, information for fabrication and installation and coordination with utilities.

D. Samples: Three applied paint samples or finish chips for easch item specified.

E. Manufacturer's Current Printed Instructions:

1. Furniture Manufacturer's Cleaning Instructions.
2. Furniture Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE:

A. Regulatory Requirements:

1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over such Work.
2. Provide for inspections and permits required by Federal, State and local authorities in furnishing, transporting, and installing materials.

1.6 WARRANTY

A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from date of Final Completion against defects in materials and workmanship.

B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship.

C. Exceptions: Contractor shall not be held responsible for failures due to normal wear, abuse or neglect by others, vandalism and other causes outside the Contractor's control.

PART 2 PRODUCTS

2.1 MANUFACTURERS AND SUPPLIERS

A. See drawings.

2.2 MANUFACTURED UNITS

A. Refer to Drawings for design, sizes, and quantities.

2.3 MATERIALS

A. Anchor Bolt Adhesive: ASTM C 881, 2-component, chemical resistant, structural epoxy bonding system designed for use in anchoring threaded rods, bolts, reinforcing bars, and smooth dowels into solid material.

B. Threaded Rod: ASTM F 593, Type 316, stainless steel.

C. Nuts for Threaded Rod: ASTM F 594, Type 316, stainless steel.

D. Anchor Bolts: As supplied by furniture manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

B. Notification of Unsuitable Conditions: Before proceeding with Work, notify the Owner in writing of unsuitable conditions.

3.2 PREPARATION

A. Protection:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
2. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
3. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
5. Submit written notification of conditions damaged during construction to the Owner’s Designated Representative immediately.

3.3 INSTALLATION

A. Bench: Install in locations as shown in the drawings.

B. Fixed Bollards: Install in locations as shown in the drawings.

C. Bike Racks: Install in locations as shown in the drawings.

D. Fire Pits: Install in locations as shown in the drawings with coordinated utility stub outs.

E. Fiberglass Planters: Install in locations as shown in the drawings.

F. Bar tops and supports: Install in locations as shown in the drawings.

3.4 CLEANING

A. General: Clean and keep clean until date of Final Completion.

B. Furniture Cleaning Method: Meet requirements of manufacturer's current printed instructions.

3.5 PROTECTION

A. Furniture Storage: Protect furniture from damage due to construction Work operations and vandalism until date of Final Completion.

END OF SECTION

SECTION 14 2100.13 – ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies electric traction elevators.

B. Work Required:

1. Elevators 1 & 2.
2. The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.
3. In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation.

C. Related work not specified herein: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.

1. Hoistway and Pit:
   a) Clear, plumb, substantially flush hoistway with variations not to exceed 1" at any point.
   b) Bevel cants not less than 75 degrees from the horizontal on any rear or side wall ledges and beams that project or recess 2" or more into the hoistway. Not required on hoistway divider beams.
2. Divider beams between adjacent elevators at each floor, pit, and overhead. Supports at each floor for car and counterweight guide rail fastening. Intermediate car guide rail support when floor heights exceed 14'-0" (non-applicable on OSHPD projects). Building supports not to deflect in excess of 1/8" under normal conditions, ¼" under applicable seismic conditions.
3. Continuous vertical car and counterweight guide rail support between floors shown on Contract Documents.
4. Installation of guide rail bracket supports in concrete. Inserts or embeds, if used will be furnished under this Section.
5. Wall blockouts and fire rated closure for control and signal fixture boxes which penetrate walls.
6. Cutting and patching walls and floors.
7. Structural slab, concrete wall pockets and/or structural steel beams for support of hoist machine, rope sheaves, and dead-end hitch beams. Support deflection shall not exceed 1/1666 of span under static load. Concrete or structural steel machine hold down means for hoist machine mounted offset from hoistway or below bottom landing.
8. Erect front hoistway wall after elevator entrances are installed.
9. Grout floor up to hoistway sills.
10. Pit access ladder for each elevator.
11. Structural support at pit floor for buffer impact loads, guide rail loads.
12. Waterproof pit. Indirect waste drain or sump with flush grate and pump.
13. Protect open hoistways and entrances during construction per OSHA Regulations.
14. Protect car enclosure, hoistway entrance assemblies, and special metal finishes from damage.
15. Hoistway venting.

16. Seal fireproofing to prevent flaking.
17. Full width hoistway header to support each entrance assembly.
18. Fire caulking, fire sealing, fire stopping, fire pads and patching of fireproofing.
19. Pit screen between adjacent elevators.
20. Fire and/or smoke doors.
21. Hoisting of machine beams, machines and controllers.
22. Finished flooring in elevator cabs.

D. Applicable Codes: Comply with applicable building and elevator codes at the project site, including but not limited to the following:

1. 2010 ADA Standards.
2. CBC Chapter 11B for Accessibility.
3. California Building Code (CBC).
4. ANSI/NFPA 70, National Electrical Code.
5. ANSI/NFPA 80, Fire Doors and Windows.
6. ASME/ANSI A17.7, Safety Code for Elevators and Escalators.
7. ANSI/UL 10B, Fire Tests of Door Assemblies.
8. EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger
9. conveyors Part 2 – immunity"
10. Guide for Inspection of Elevators, Escalators and Moving Walks, ASME A17.2
    Elevator and Escalator Electrical Equipment, ASME A17.5
11. Requirements of IBC, OSHPD, and all other codes, ordinances and laws applicable within the
12. governing jurisdiction.
13. Life Safety Code, NFPA 101, and California Code Regulations Title 19
    Uniform Federal Accessibility Standard, UFAS
14. California Code of Regulations Title 8 and Title 24
15. Local Building Codes/Fire Authority
16. All other local applicable codes.

1.2 SYSTEM DESCRIPTION

A. Equipment Description: Gen2® gearless machine-room less elevator where all components fit inside the hoistway.

B. Equipment Control: Elevonic® Control System.

C. Drive: Regenerative

D. Quantity of Elevators: (2) Two

E. Elevator Stop Designations: Front only at LL, 1, 2, 3, 4

F. Stops : (5) Five

G. Openings: (5) Five in line.

H. Travel (maximum): 63 ft.

I. Rated Capacity: 3500 lb.

J. Rated Speed: 350 fpm.

K. Platform Size: 6'-6 ¾" W x 6'-1 1/8" D

L. Clear Inside Dimensions: 6'-5 9/16" W x 5'-5 9/16" D

M. Cab Height: 9'9"

N. Clear Cab Height: 9'-3 3/8" with 1-1/4" floor recess and dropped 6 LED

O. Entrance Type and Width: Center-Open Doors 42"

P. Entrance Height: 8'-0"

Q. Main Power Supply: 480 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor.

R. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.

S. Machine Location: Inside the hoistway at the top of the hoistway.

T. Signal Fixtures: As described in Paragraph 2.05

U. Controller Location: Controller(s) Shall be Located on floor one in an Adjacent Machine Room Housing the Controllers for Elevators #1, #2

V. Performance:

1. Car Speed: ± 3 % of contract speed under any loading condition or direction of travel.
2. Car Capacity: Safely lower, stop and hold up to 120% of rated load. (code required).
3. Ride Quality:
   a. Vertical Vibration (maximum): 20 milli-g
   b. Horizontal Vibration (maximum): 12 milli-g
   c. Vertical Jerk (maximum): 4.59 □□1.0 ft./ sec^3 (1.4 □□0.3 m/ sec^3)
   d. Acceleration/Deceleration (maximum): 2.62 ft./ sec^2 (0.8 m/ sec^2)
   e. In Car Noise: 55 – 60 dB(A)
   f. Stopping Accuracy: □□0.375 in. (□□10 mm) max, □□0.25 in. (□□6 mm) Typical
   g. Re-leveling Distance: □□0.5 in. (□□12 mm)

W. Operation: Duplex Collective Operation: Using a microprocessor-based controller, the operation shall be automatic by means of the car and hall buttons. In the absence of system activity, one car can be made to park at the pre-selected main landing. The other (free) car shall remain at the last landing served. Only one car shall respond to a hall call. If either car is removed from service, the other car shall immediately answer all hall calls, as well as its own car calls.

X. Operating Features – Standard
1. Full Collective Operation
2. Anti-nuisance.
3. Fan and Light Protection.
4. Load Weighing Bypass.
5. Independent Service.
6. Full Collective Operation.
7. Firefighters' Service Phase I and Phase II

8. Top of Car Inspection.
9. Zoned Car Parking.
10. Relative System Response Dispatching.

Y. Door Control Features:
1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
3. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

Z. Provide equipment according to Seismic Zone 4.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
1. Signal and operating fixtures, operating panels and indicators.
2. Cab design, dimensions and layout.
3. Hoistway-door and frame details.
4. Electrical characteristics and connection requirements.
5. Expected heat dissipation of elevator equipment in hoistway (BTU).
6. Color selection chart for Cab and Entrances.

B. Shop Drawings: Submit approval layout drawings. Include the following:
1. Car, guide rails, buffers and other components in hoistway.
2. Maximum rail bracket spacing.
3. Maximum loads imposed on guide rails requiring load transfer to building structure.
4. Clearances and travel of car.
5. Clear inside hoistway and pit dimensions.
6. Location and sizes of access doors, hoistway entrances and frames.

C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.4 QUALITY ASSURANCE

A. Manufacturer: Minimum of fifteen years experience in the fabrication, installation and service of elevators of the type and performance of the specified. The manufacturer shall have a documented quality assurance program. ISO 9001 Certified

B. Installer: Elevators shall be installed by the manufacturer.

C. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made

in the presence of such authorities or their authorized representatives.

1.5 DELIVERY, STORAGE AND HANDLING

A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.

Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.6 WARRANTY

A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.7 MAINTENANCE and SERVICE

A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of twelve (12) months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

B. The periodic lubrication of elevator components shall <u>not</u> be required, including: Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc

C. The elevator control system must:

1) Provide in the controller the necessary devices to run the elevator on inspection operation.
2) Provide on top of the car the necessary devices to run the elevator in inspection operation.
3) Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
4) Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
5) Provide the means from the controller to reset the governor over speed switch and also trip the governor.
6) Provide the means from the controller to reset the emergency brake when set because of an

unintended car movement or ascending car over speed.
7) Provide the means from the controller to reset elevator earthquake operation.

D. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:

1. Remotely diagnose elevator issues with a remote team of experts
2. Remotely return an elevator to service
3. Provide real-time status updates via email
4. Remotely make changes to selected elevator functions including:
    a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak/down peak mode, activate independent service
    b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s)
    c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers

PART 2 - PRODUCTS

2.1 DESIGN AND SPECIFICATIONS

A. Provide machine-roomless Gen2™ traction passenger elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:
1. An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
2. Polyurethane Coated-Steel Belts for elevator hoisting purposes.
3. Regenerative drive that captures normally wasted energy and feeds clean power back into the building's power grid.
4. LED lighting standard in ceiling lights and elevator fixtures.
5. Sleep mode operation for LED ceiling lights and car fan.

B. Approved Installer: Otis Elevator Company

2.2 EQUIPMENT: CONTROLLER COMPONENTS

A. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.
1. All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.

3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
5. Controller shall be located inside the wall next to the top landing entrance frame. Emergency access shall be provided through an access panel in the entrance frame secured by a key lock.
6. A separate control room or cabinet should not be required.

B. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

2.3 EQUIPMENT: MACHINE AND GOVERNOR

A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.

B. Governor: The governor shall be a tension type car-mounted governor.

C. Buffers, Car and Counterweight: Polyurethane type buffers shall be used.

C. Hoistway Operating Devices:
1. Emergency stop switch in the pit
2. Terminal stopping switches.

D. Positioning System: Consists of an encoder, reader box, and door zone vanes.

E. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

F. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. All driving sheaves and deflector sheaves should have a crowned profile to ensure center tracking of the belts. A continuous 24/7 monitoring system using resistance based technology has to be installed to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.

G. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.

H. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.

I. Hoistway Entrances:

1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
2. Sills shall be extruded aluminum.

3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour(for M1,M2, M3, D1, D2; 1 hour for D3 Entrance Arrangements.
5. Entrance and Door Frame Finish: Otis #4 Satin Stainless Steel
6. Entrance marking plates: Entrance jambs shall be marked with 4" x 4" (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
7. Sight Guards: sight guards will be furnished with all doors- #4 stainless steel.

2.4 EQUIPMENT: CAR COMPONENTS

A. Car frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.

B. Cab Options: Premium Cab Options: Vertical raised panels faced with Stainless Steel with black reveals between panels. Brushed Stainless Steel finished base plate located at top and bottom

C. Car Front Finish: Otis #4 Satin Stainless Steel.

D. Car Door Finish: Otis #4 Satin Stainless Steel.

E. Ceiling Type: Dropped Brushed Steel Finish with 6 LED lights.

F. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.

G. Fan: A one-speed 120 VAC fan will be mounted to the ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.

H. Handrail: Handrails shall be provided on side and rear walls of the car enclosure. Handrails shall be 1 ½" diameter (38.1 mm) Round bar handrail with a Brushed Steel.

I. Threshold: Extruded Aluminum.

J. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

K. Guides: The car shall have 3" diameter roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom.

L. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.

M. Certificate frame: Provide a Certificate frame with a satin stainless steel finish.

N. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

O. Finished Flooring: To be furnished and installed by others. Set car sill recess at 1-1/4".

2.5 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish.

B. A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with 1/8" (3mm) satin stainless steel projecting button with blue illuminating halo. The car operating panel shall be equipped with the following features:

1. Raised markings and Braille to the left hand side of each push-button.
2. Car Position Indicator at the top of an integral to the car operating panel.
3. Door open and door close buttons.
4. Inspection key-switch.
5. Elevator Data Plate marked with elevator capacity and car number.
6. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
7. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
8. In car stop switch (toggle or key unless local code prohibits use)
9. Firefighter's hat
10. Firefighter's Phase II Key-switch
11. Call Cancel Button
12. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to A17.1 2000, Article 2.27.7.2.
13. Please Exit Symbol: provided in the hall.

C. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.

D. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Hall fixtures shall have #4 satin stainless steel.

1. Hall position indicator at: LL

Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the wall. Buttons shall be in vertically mounted fixture. Fixture shall be satin stainless steel.

Button Options:

1/8" (3mm) satin stainless steel projecting button with blue or white illuminating halo or gold satin button with white illuminating halo>

E. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.
F. Access key-switch at top floor in entrance jamb.
G. Access key-switch at lowest floor in entrance jamb.
H. Card Reader Provision in traveling cable (Card Reader furnished and installed by others)

PART 3 - EXECUTION

3.1 PREPARATION

A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Installation of all elevator components except as specifically provided for elsewhere by others.

B. Installation of equipment shall be based upon Otis' FIT installation method which states that the following conditions are agreed upon and required by others before manning the job: Clear, completed hoistways, control room walls up, lobby floors poured/constructed at all landings, three (3) phase power of permanent characteristics to run elevators, storage area adjacent to hoistways at lowest landing, uninterrupted use of hoistways, and properly located supports for rails and entrances.

3.3 DEMONSTRATION

A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION

SECTION 14210.16 – ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Elevator #3.

B. This Section specifies electric traction elevators.

C. Related work not specified herein: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.

a. Hoistway and Pit:

1. Section 01500 - Construction Facilities and Temporary Controls: protection of floor openings and personnel barriers; temporary power and lighting.
2. Section 02200 - Earthwork: excavation for elevator pit.
3. Section 03300 - Cast-In-Place Concrete: elevator pit, and elevator machine foundation.
4. Section 04200 - Unit Masonry: masonry hoistway enclosure, building-in and grouting hoistway doorframes, and grouting of sills.
5. Section 05500 - Metal Fabrications: pit ladder, divider beams, and supports for entrances, rails and hoisting beam at top of elevator hoistway.
6. Section 07145 - Cementitious Waterproofing: waterproofing of elevator pit.
7. Section 15500 - Heating, Ventilating, and Air Conditioning: ventilation and temperature control of elevator equipment areas.
8. Section 16100 - Electrical:
   a. Main disconnects for each elevator.
   b. Electrical power for elevator installation and testing.
   c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
   d. The installation of dedicated GFCI receptacles in the pit and overhead.
   e. Lighting in controller area, machine area and pit.
   f. Wiring for telephone service to controller.
9. Section 16610 – Emergency (Standby) Power Supply Systems: emergency generator for elevator operation.
10. Section 16720 - Fire Alarm Systems: The installation of fire and smoke detectors at required locations and interconnecting devices; fire alarm signal lines to contacts in the machine area.
11. Section 16740 - Telephone Systems: ADAAG-required emergency communications equipment.

D. Applicable Codes: Comply with applicable building and elevator codes at the project site, including but not limited to the following
1. 2010 ADA Standards.
2. CBC Chapter 11B for Accessibility.
3. ANSI/NFPA 70, National Electrical Code.
4. ANSI/NFPA 80, Fire Doors and Windows.
5. ASME/ANSI A17.7, Safety Code for Elevators and Escalators.
6. ANSI/UL 10B, Fire Tests of Door Assemblies.
7. EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger
8. conveyors Part 2 – immunity"
9. Local Building Codes
10. All other local applicable codes.

1.2 SYSTEM DESCRIPTION

A. Equipment Description: Gen2® gearless traction elevator
B. Equipment Control: Elevonic® Control System.
C. Drive: Regenerative
D. Quantity of Elevators: 1
E. Elevator Stop Designations: Front Only At LL,1,2,3,4,R
F. Stops : 6
G. Openings: Front Only
H. Travel: 77 ft 8 in
I. Rated Capacity: 5000 lbs Service
J. Rated Speed: 200 fpm
K. Platform Size:6' 0-1/2" wide x 9' 1-1/4" deep
L. Clear Inside Dimensions: 5'-11 5/16" W x 8'-4 3/16" D
M. Cab Height: 9'-9"
N. Clear Cab Height: 9' 3 3/8" with 1-1/4" floor recess and dropped 6 LED
O. Entrance Type and Width: Two Speed Side Slide 54" doors
P. Entrance Height: 8'-0"
Q. Main Power Supply: 480 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor.
R. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
S. Signal Fixtures: As described in paragraph 2.05.
T. Controller Location: Controller(s) shall be located in the machine room
U. Performance:
1. Car Speed: $\pm$3 % of contract speed under any loading condition or direction of travel.
2. Car Capacity: Safely lower, stop and hold up to 120% of rated load. (code required).
V. Ride Quality:
1. Vertical Vibration (maximum): 20 milli-g

2. Horizontal Vibration (maximum): 12 milli-g
3. Vertical Jerk (maximum): 4.59 □□1.0 ft./ sec3 (1.4 □□0.3 m/ sec3)
4. Acceleration/Deceleration (maximum): 2.62 ft./ sec2 (0.8 m/ sec2)
5. In Car Noise: 55 – 60 dB(A)
6. Stopping Accuracy:: ± 0.375 in. (± 10 mm) max, ± 0.25 in. (± 6 mm) Typical
7. Re-leveling Distance: □□0.5 in. (□□12 mm)

W. Simplex Collective Operation:
1. Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

X. Operating Features – Standard
1. Full Collective Operation
2. Anti-nuisance.
3. Fan and Light Protection.
4. Load Weighing Bypass.
5. Full Collective Operation.
6. Firefighters' Service Phase I and Phase II:
7. Top of Car Inspection.

Y. Operation Features – Optional
1. Zoned Access at Bottom Landing.
2. Zoned Access at Upper Landing.

Z. Door Control Features:
1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
   Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
3. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

AA. Provide equipment according to: Seismic Zone 4

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each system proposed for use. Include the following:
1. Signal and operating fixtures, operating panels and indicators.
2. Cab design, dimensions and layout.
3. Hoistway-door and frame details.
4. Electrical characteristics and connection requirements.

5. Expected heat dissipation of elevator equipment in control room space and machine space (BTU).
6. Color selection chart for Cab and Entrances.

B. Shop Drawings: Submit approval layout drawings. Include the following:
1. Car, guide rails, buffers and other components in hoistway.
2. Maximum rail bracket spacing.
3. Maximum loads imposed on guide rails requiring load transfer to building structure.
4. Clearances and travel of car.
5. Clear inside hoistway and pit dimensions.
6. Location and sizes of access doors, hoistway entrances and frames.

C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.4 QUALITY ASSURANCE

A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.

B. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.5 DELIVERY, STORAGE AND HANDLING

A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.
1. Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.6 WARRANTY

A. The elevator contractor’s acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The guarantee period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The guarantee excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.7 MAINTENANCE and SERVICE

A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of 12 months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days and shall include emergency 24- hour callback service. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

B. The periodic lubrication of elevator components shall not be required, including: Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc.

C. The elevator control system must:
1. Provide in the controller the necessary devices to run the elevator in inspection operation.
2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
4. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.

D. Provide the means from the controller to reset elevator earthquake operation.

E. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:
1. Remotely diagnose elevator issues with a remote team of experts
2. Remotely return an elevator to service
3. Provide real-time status updates via email
4. Remotely make changes to selected elevator functions including:
   a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak/down peak mode, activate independent service
   b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s)
   c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers

PART 2 - PRODUCTS

2.1 DESIGN AND SPECIFICATIONS

A. Provide Provide Gen2™ traction passenger elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:
1. An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
2. Polyurethane Coated-Steel Belts for elevator hoisting purposes.
3. Regenerative drive that captures normally wasted energy and feeds clean power back into the building's power grid.
4. LED lighting standard in ceiling lights and elevator fixtures.
5. Sleep mode operation for LED ceiling lights and car fan.

B. Approved Installer: Otis Elevator Company

2.2 EQUIPMENT: CONTROLLER COMPONENTS

A. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.
1. All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC.
4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
5. Controller shall be located inside the wall next to the top landing entrance frame. Emergency access shall be provided through an access panel in the entrance frame secured by a key lock.
6. A separate control room or cabinet should not be required.

B. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

2.3 EQUIPMENT: MACHINE AND GOVERNOR

A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.
B. Governor: The governor shall be a tension type car-mounted governor.
C. Buffers, Car and Counterweight: Polyurethane type buffers shall be used.
D. Hoistway Operating Devices:

1. Emergency stop switch in the pit
2. Terminal stopping switches.

E. Positioning System: Consists of an encoder, reader box, and door zone vanes.

F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. All driving sheaves and deflector sheaves should have a crowned profile to ensure center tracking of the belts. A continuous 24/7 monitoring system using resistance based technology has to be installed to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.

H. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.

I. Fascia: Galvanized sheet steel shall be provided at the front, and rear, of the hoistway.

J. Hoistway Entrances:

1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
2. Sills shall be extruded aluminum.
3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour (for M1, M2, M3, D1, and D2 Entrance Arrangements or 1 hour for D3 Entrance Arrangement.
5. Entrance Finish
   Stainless Steel at Front LL,1,2,3,4,R
6. Frame Finish
   Stainless Steel at Front LL,1,2,3,4,R
7. Entrance marking plates: Entrance jambs shall be marked with 4” x 4” (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
8. Sight Guards: Black sight guards will be furnished with all doors.

2.4 EQUIPMENT: CAR COMPONENTS

A. Carframe and Safety: A carframe fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the carframe and shall be Type "B", flexible guide clamp type.

B. Cab Options: Premium Cab Options: Vertical raised panels faced with Stainless Steel with black reveals between panels. Brushed Stainless Steel finished base plate located at top and bottom.

C. Car Front Finish: Satin Stainless Steel.

D. Car Door Finish: Satin Stainless Steel

E. Ceiling Type: Brushed Steel Finish (BSF) Dropped Steel Ceiling with 6 LED Lights

F. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.

G. Fan: A one-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.

H. Handrails: Handrails shall be provided on the Side & Rear walls of the car enclosure. Handrails shall be 1 ½" (38.1mm) dia. Round Bar with a Brushed Steel Finish

I. Threshold: Extruded Aluminum

J. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

K. Guides: The car shall have 3" diameter roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom.

L. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.

M. Zoned Certificate frame- Provide a Certificate frame with a satin stainless steel finish.

N. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

O. Finished Flooring: To be furnished and installed by others. Set car sill recess at 1-1/4".

2.5 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish.

1. A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with these options:
   a. 1/8" (3mm) satin stainless steel projecting button with blue illuminating halo
2. The car operating panel shall be equipped with the following features:
   a. Raised markings and Braille to the left hand side of each push-button.
   b. Car Position Indicator at the top of and integral to the car operating panel.
   c. Door open and door close buttons.
   d. Inspection key-switch.
   e. Elevator Data Plate marked with elevator capacity and car number.
   f. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
   g. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
   h. In car stop switch (toggle or key unless local code prohibits use)
   i. Firefighter's hat
   j. Firefighter's Phase II Key-switch
   k. Call Cancel Button
3. Optional
   a. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to A17.1 2000, Article 2.27.7.2.
   b. Please Exit Symbol provided in the hall.

B. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.
   1. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Hall fixtures shall feature:
      a. Stainless Steel Hall Position Indicators at: LL
   2. Integral Hall fixtures shall feature:
      a. Round stainless steel, mechanical buttons marked to correspond to the landings.
      b. Hall fixtures to be located in the entrance frame face. Therefore, separate wiring and installation of electrical boxes inside the wall for the hall buttons are not required.
      c. Buttons shall be in vertically mounted fixture. Fixture shall be satin stainless steel finish.
   3. Button Options:
      a. 1/8" (3mm) satin stainless steel projecting button with blue illuminating halo

C. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.

D. Access key-switch at top floor in entrance jamb.

E. Access key-switch at bottom floor in entrance jamb.

F. Card reader provisions in traveling cable (Card Reader furnished and installed by others)

PART 3 - EXECUTION

3.1 PREPARATION

A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALATION

A. Installation of all elevator components except as specifically provided for elsewhere by others.

B. Installation of equipment shall be based upon Otis' FIT installation method which states that the completed hoistways, control room walls up, lobby floors poured/constructed at all landings, three at lowest landing, uninterrupted use of hoistways, and properly located supports for rails and entrances.

3.3 DEMONSTRATION

A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION

SECTION 14 2400 – HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies hydraulic elevators.
B. Elevator #4.
C. Work Required:
1. The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.
2. All work shall be performed in a first class, safe and workmanlike manner.
3. In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation.

D. Related work not specified herein: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.
1. Division 01 - Construction Facilities and Temporary Controls: protection of floor openings and personnel barriers; temporary power and lighting.
2. Division 31 - Earthwork: excavation for cylinder well casing.
3. Division 03 - Cast-In-Place Concrete: elevator pit, elevator motor and pump foundation, and grouting thresholds.
4. Division 04 - Unit Masonry: masonry hoistway enclosure, building-in and grouting hoistway door frames, grouting thresholds.
5. Division 05 - Metal Fabrications: pit ladder, divider beams, support for entrances and rails, hoisting beam at top of hoistway.
6. Division 07 - Cementitious Waterproofing: waterproofing of elevator pit.
7. Division 26 - Electrical: Section 16100 - Electrical:
a. Main disconnects for each elevator.
b. Electrical power for elevator installation and testing.
c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
d. The installation of dedicated GFCI receptacles in the pit and overhead.
e. Lighting in controller area, machine area and pit.
f. Wiring for telephone service to controller.
8. Division 26 - Standby Power Supply Systems: emergency generator for elevator operation.
9. Division 28 - Fire Alarm Systems: fire and smoke detectors and interconnecting devices; fire alarm signal lines to contacts in the machine area.
10. Division 27 - Telephone Systems: ADAAG-required emergency communications equipment.

E. Applicable Codes: Comply with applicable building and elevator codes at the project site,

including but not limited to the following:

1. 2010 ADA Standards.
2. CBC Chapter 11B for Accessibility.
3. ANSI/NFPA 70, National Electrical Code.
4. ANSI/NFPA 80, Fire Doors and Windows.
5. ASME/ANSI A17.7, Safety Code for Elevators and Escalators.
6. ANSI/UL 10B, Fire Tests of Door Assemblies.
7. EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger
8. conveyors Part 2 – immunity"
9. Local Building Codes.
10. All other local applicable codes.

1.2 SYSTEM DESCRIPTION

A. Equipment Description: Equipment Description: Holeless Hydraulic elevator
B. Equipment Control: Elevonic® Control System.
C. Quantity of Elevators: 1
D. Elevator Stop Designations: Front Only At LL,1
E. Stops : 2
F. Openings: In Line
G. Travel: 19 ft 0 in 0
H. Rated Capacity: 4500 lbs Service
I. Rated Speed: 125 fpm
J. Platform Size: 5' 6- 3/4" wide x 8' 8- 1/16" deep
K. Clear Inside Dimensions: 5 ft 5 in 9/16 wide x 7 ft 10 in 15/16 deep
L. Cab Height: 93"
M. Clear Cab Height: 7' 7- 1/16"
N. Entrance Type and Width: Two Speed Side Slide 48" doors
O. Entrance Height: 7' 0"
P. Main Power Supply: 480 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor.
Q. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
R. Machine and Controller Location at landing: LL
S. Signal Fixtures: As Decribed in paragraph 2.05
T. Stopping Accuracy: ±1/4" (6.4 mm) under any loading condition or direction of travel.
U. Operation: Simplex Collective Operation- Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
V. Operating Features – Standard
   1. Full Collective Operation
   2. Fan and Light Protection, Sleep Mode
   3. Independent Service.
   4. Full Collective Service.

5. Firefighters' Service Phase I and Phase II.
6. Top of Car Inspection.

W. Operation Features – Optional
1. Zoned Access at Bottom Landing.
2. Zoned Access at Upper Landing.

X. Door Control Features:
1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
   Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
3. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

Y. Provide equipment according to: Seismic Zone 4

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
1. Signal and operating fixtures, operating panels and indicators.
2. Cab design, dimensions and layout.
3. Hoistway-door and frame details.
4. Electrical characteristics and connection requirements.
5. Expected heat dissipation of elevator equipment in hoistway (BTU).
6. Color selection chart for Cab and Entrances.

B. Shop Drawings: Submit approval layout drawings. Include the following:
1. Car, guide rails, buffers and other components in hoistway.
2. Maximum rail bracket spacing.
3. Maximum loads imposed on guide rails requiring load transfer to building structure.
4. Clearances and travel of car.
5. Clear inside hoistway and pit dimensions.

6. Location and sizes of access doors, hoistway entrances and frames.

C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.4 QUALITY ASSURANCE

A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.
B. Installer: Elevators shall be installed by the manufacturer.
C. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.5 DELIVERY, STORAGE AND HANDLING

A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.
   1. Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.6 WARRANTY

A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.7 MAINTENANCE and SERVICE

A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of 12 months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.
B. The elevator control system must:
   1. Provide in the controller the necessary devices to run the elevator on inspection operation.
   2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
   3. Provide in the controller an emergency stop switch. This emergency stop switch when

opened disconnects power from the brake and prevents the motor from running.

C. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:

1. Remotely diagnose elevator issues with a remote team of experts
2. Remotely return an elevator to service
3. Provide real-time status updates via email
4. Remotely make changes to selected elevator functions including:
   a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak / down peak mode, activate independent service
   b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s)
   c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers

PART 2 - PRODUCTS

2.1 DESIGN AND SPECIFICATIONS

A. Provide holeless hydraulic elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:

1. Sleep mode operation for LED ceiling lights and car fan.
2. LED lighting standard in ceiling lights and elevator fixtures.
3. Sleep mode operation for LED ceiling lights and car fan.

B. Approved Installer: Otis Elevator

2.2 EQUIPMENT: MACHINE COMPONENTS

A. The hydraulic system shall be of compact design suitable for operation under the required pressure. The power component shall be mounted in the hydraulic-fluid storage tank. The control valve shall control flow for up and down directions hydraulically and shall include an integral check valve. A control section including control solenoids shall direct the main valve and control: up and down starting, acceleration, transition from full speed to leveling speed, up and down stops, pressure relief and manual lowering. All of these functions shall be fully adjustable for maximum smoothness and to meet contract conditions. System to be provided with a low- pressure switch and a shut-off valve.

B. A microprocessor-based controller shall be provided, including necessary starting switches together with all relays, switches, solid-state components and hardware required for operation, including door operation, as described herein. A three (3) phase overload device shall be provided to protect the motor against overloading.

C. A manual lowering feature shall permit lowering the elevator at slow speed in the event of power failure or for adjusting purposes.
D. Pressure Switch
E. Low-oil control.

2.3 EQUIPMENT: HOISTWAY COMPONENTS

A. Plunger(s) and Cylinder(s): Each cylinder shall be constructed of steel pipe of sufficient thickness and suitable for the operating pressure. The top of each cylinder shall be equipped with a cylinder head with a drip ring to collect any oil seepage as well as an internal guide ring and self-adjusting packing. Each plunger shall be constructed of selected steel tubing or pipe of proper diameter machined true and smooth with a fine polished finish. Each plunger shall be provided with a stop ring electrically welded to it to prevent the plunger from leaving the cylinder. Each plunger and cylinder shall be installed plumb and shall operate freely with minimum friction.
B. Car Guide Rails: Tee-section steel rails with brackets and fasteners.
C. Polyurethane type buffers shall be used.
D. Wiring: Wiring for hoistway electrical devices included in scope of the elevator system, hall panels, pit emergency stop switch, and the traveling cable for the elevator car.
E. Hoistway Entrances:
1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
2. Sill Finish(es):
Extruded Aluminum at Front LL,1
3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour (for M1, M2, M3, D1, and D2 Entrance Arrangements or 1 hour for D3 Entrance Arrangement.
5. Entrance Finish(es):
Stainless Steel at Front LL,1
6. Frame Finish(es):
Stainless Steel at Front LL,1
7. Entrance marking plates: Entrance jambs shall be marked with 4” x 4” (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
8. Sight Guards: Black sight guards will be furnished with all doors.

F. Fascia: Galvanized sheet steel shall be provided at the front, and rear, of the hoistway.

2.4 EQUIPMENT: CAR COMPONENTS

A. Cab Options: Premium Cab Options: Vertical raised panels faced with Stainless Steel with black revels between panels. Brushed Stainless Steel finished base plate located at top and bottom.

B. Car Front Finish: Satin Stainless Steel.
C. Car Door Finish: Satin Stainless Steel.
D. Ceiling Type: Brushed Steel Finish (BSF) Dropped Steel Ceiling with 6 LED Lights
E. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.
F. Fan: A one-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.
G. Handrails: Handrails shall be provided on the Side & Rear walls of the car enclosure. Handrails shall be 1 ½" (38.1mm) dia. Round Bar with a Brushed Steel Finish
H. Threshold: Extruded Aluminum
I. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
J. Guides: Car roller type guides at the top and the bottom.
K. Platform: Car platform shall be constructed of metal.
L. Certificate frame- Provide a Certificate frame with a satin stainless steel finish.
M. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.
N. Finished Flooring: To be furnished and installed by others, Set car recess at 1-1/4".

2.5 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish.
   1. A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with:
      a. 1/8" (3mm) satin stainless steel projecting button with blue illuminating halo
   2. The car operating panel shall be equipped with the following features:
      a. Raised markings and Braille to the left hand side of each push-button.
      b. Car Position Indicator at the top of and integral to the car operating panel.
      c. Door open and door close buttons.
      d. Inspection key-switch.
      e. Elevator Data Plate marked with elevator capacity and car number.
      f. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
      g. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
      h. In car stop switch (toggle or key unless local code prohibits use)
      i. Firefighter's hat

j. Firefighter's Phase II Key-switch
k. Call Cancel Button

3. Optional
   a. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to A17.1 2000, Article 2.27.7.2.
   b. Please Exit Symbol provided in the hall.

B. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.

C. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation.
   1. Hall fixtures shall feature:
      a. Stainless Steel Hall Position Indicators at: LL
   2. Integral Hall fixtures shall feature:
      a. Round stainless steel, mechanical buttons marked to correspond to the landings.
      b. Hall fixtures to be located in the entrance frame face. Therefore, separate wiring and installation of electrical boxes inside the wall for the hall buttons are not required.
      c. Buttons shall be in vertically mounted fixture.
      d. Fixture shall be satin stainless steel finish.
   3. Button Options:
      a. 1/8" (3mm) satin stainless steel projecting button with blue illuminating halo

D. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.
E. Access key-switch at top floor in entrance jamb.
F. Access key-switch at bottom floor in entrance jamb.
G. Card reader provisions in traveling cable (Card Reader furnished and installed by others)

PART 3 - EXECUTION

3.1 PREPARATION

A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Installation of all elevator components except as specifically provided for elsewhere by others.
B. Installation of equipment shall be based upon Otis' FIT installation method which states that the completed hoistways, control room walls up, lobby floors poured/constructed at all landings, three at lowest landing, uninterrupted use of hoistways, and properly located supports for rails and entrances.

3.3 DEMONSTRATION

A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION

SECTION 21 1000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following fire-suppression piping inside the building:

1. Manual wet-type, Class I standpipe systems.
2. Wet-pipe sprinkler systems.
3. Combined Standpipe and Sprinkler Systems.
4. Construction Standpipe System in accordance with 2007 California Building Code (CBC) section 904.6.

B. Related Sections include the following:

1. Division 10 Section "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.
2. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.
3. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
4. Division 33 Section "Facility Water Distribution Piping" for piping outside the building.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.

C. C. PE: Polyethylene plastic.

D. Underground Service-Entrance Piping: Underground service piping below the building.

1.3 SYSTEM DESCRIPTIONS

A. Combined Standpipe and Sprinkler System: Fire-suppression system with both standpipe and sprinkler systems. Sprinkler system is supplied from standpipe system.

B. Manual Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.

C. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Fire-suppression standpipe system design shall comply with Campus Fire Marshal requirements and be approved by Campus Fire Marshal.

1. Minimum residual pressure at each hose-connection outlet is the following:

a. NPS 1-1/2 Hose Connections: 65 psig
b. NPS 2-1/2 Hose Connections: 100 psig

2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose-connection outlet:

a. NPS 1-1/2 Hose Connections: 100 psig
b. NPS 2-1/2 Hose Connections: 175 psig

C. Fire-suppression sprinkler system design shall be approved by Campus Fire Marshal.

1. Margin of Safety for Available Water Flow and Pressure 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:
3. The maximum design pressure available at the fire department connection is 150 psig. The calculation shall not exceed this pressure under any circumstances.

4. Minimum Density for Automatic-Sprinkler Piping Design: Provide per revised BOD
a. Extra-Hazard, Group 2 Occupancy: [0.40 gpm over 2500-sq. ft.] area.
b. Group L or B, Laboratory Area Occupancy: 0.17 gpm/sq. ft. over 3,000 sq. ft. Other portions of the building not classified as Laboratory shall be Ordinary Hazard, Group 1 Occupancy: 0.12 gpm/sq. ft. over 3,000 sq. ft.
c. Special Occupancy Hazard: As determined by Campus Fire Marshal.

5. Maximum Protection Area per Sprinkler: 130 sq. ft.

a. Office Spaces: 130 sq. ft.
b. Storage Areas: 130 sq. ft..
c. Mechanical Equipment Rooms: 130 sq. ft..
d. Electrical Equipment Rooms: 130 sq. ft..
e. Other Areas: 130 sq. ft., unless otherwise required by Campus Fire Marshal.
f. Reduction in area for use of quick response sprinklers is not allowed.
g. Upon delivery of materials provide welded outlet inspection

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
a. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes
b. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

D. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and California Building Code (CBC) for Seismic zone 4.

1.5 SUBMITTALS

A. Product Data: Clearly indicate and highlight standards required to be met and California State Fire Marshal (CSFM) listing numbers for the following:

1. Pipe hangers and supports, including seismic restraints.
2. Alarm devices, including electrical data

B. Product Data: For the following:

1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
2. Pipe hangers and supports**,** including seismic restraints.
3. Listed fire-protection valves, and specialty valves and trim.
4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
5. Hose connections, including size, type, and finish.
6. Hose stations, including size, type, and finish of hose connections; type and length of fire hoses; finish of fire hose couplings; type, material, and finish of nozzles; and finish of rack.
7. Roof hose cabinets.
8. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
9. Alarm devices, including electrical data.

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Fire-hydrant flow test report.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by Campus Fire Marshal and University Representative, including hydraulic calculations.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

G. G. Welding certificates.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For standpipe and sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or C-16 California licensed contractor who has been in business for at least last three years.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
4. NFPA 25, “Inspection, Testing and Maintenance of Water Based Fire Protection Systems.”

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Sprinkler heads are required to be laid out in an orderly symmetrical pattern. Locate sprinkler heads centered in suspended ceiling tiles or for tiles wider than two feet, quarter points may be acceptable.

C. Participate in Construction Detailing Activity (CDA) in accordance with Division 01 Section “Construction Detailing Activity.”

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Piping, Valves and Fittings shall be manufactured in USA, Australia, Canada or Japan only.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, minimum thickness class 52 with mechanical-joint bell end and plain end.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110**,** epoxy coated ductile- iron standard pattern, bell and plain end. [**AWWA C110, ductile- standard pattern or AWWA C153, ductile-iron compact pattern**].
2. Glands, Gaskets, and Bolts: AWWA C111, epoxy coated ductile-iron gland, rubber gasket, and stainless steel bolts and nuts.
3. Underground piping shall be epoxy coated on interior and exterior.

B. Ductile iron fittings using push-on joint or grooved-end are not acceptable.

2.3 STEEL PIPE AND FITTINGS

A. Threaded-End, Schedule 40, Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 grade A with factory- or field-formed threaded ends. Grade A may be used for pipe 2” and smaller.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
4. Steel Threaded Couplings: ASTM A 865.

B. Plain-End, Schedule 40, Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

C. Roll-Grooved-End, Schedule 40, Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 with factory- or field-formed, roll-grooved ends. Cut-Grooved piping shall not be used.

D. Roll- Grooved End Schedule 10 Steel Pipe Astma-53 used 2 ½” and Larger

1. Roll-Grooved-Joint Piping Systems:

    a. Manufacturers:

        1) Anvil International, Inc.
        2) Central Sprinkler Corp.
        3) M & H Valve Co. Division of McWane Inc. Style 4067 National Fittings Inc.
        4) Shurjoint Piping Products, Inc.
        5) Southwestern Pipe, Inc.
        6) Star Pipe Products; Star Fittings Div.
        7) Victaulic Co. of America.
        8) Ward Manufacturing. 9) Or equal**.**

    b. Roll-Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.

    c. Roll-Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

2.4 COPPER TUBE AND FITTINGS

A. Plain-End, Hard Copper Tube: ASTM B 88, Type K], water tube, drawn temper.

1. Copper Fittings: ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings.
2. Bronze Flanges: ASME B16.24, Class 150, with brazed-joint end. Furnish Class 300 flanges if required to match tubing system.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and socket metal-to-metal seating surfaces, and brazed-joint or threaded ends.
4. Copper, Mechanically Formed Tee Option: shall not be used on Campus..
5. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4.

B. Roll-Grooved-End, Hard Copper Tube: ASTM B 88, Type K , water tube, drawn temper; with factory- or field-formed, roll-grooved ends.

1. Copper, Mechanically Formed Tee Option: Shall not be used on Campus.
2. Roll-Grooved-Joint Systems:

    a. Manufacturers:

        1) Anvil International, Inc.
        2) Victaulic Co. of America.
        3) Or equal**.**

    b. Roll-Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting. Fittings may have ends factory or field expanded to steel-pipe OD if required for copper tube systems using roll-grooved-end-pipe couplings.

c. Roll-Grooved-End-Tube Couplings: UL 213, rigid pattern, unless otherwise indicated; gasketed fitting equivalent to AWWA C606, but made to match coppertube OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated, rubber gasket listed for use with housing, and steel bolts and nuts. Use roll-grooved-end-pipe couplings for tube and fitting that have expanded ends.

2.5 DIELECTRIC FITTINGS

A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.

B. Dielectric Unions: Shall not be used on Campus.

C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.
e. Or equal**.**

D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products and Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Or equal**.**

E. Dielectric Couplings: Galvanized steel with inert and non-corrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.
c. Or equal**.**

F. Dielectric Nipples: Electroplated steel with inert and non-corrosive thermoplastic lining, with combination of plain, threaded, or roll-grooved ends and 300-psig working-pressure rating at 225 deg F.
   1. Manufacturers:

      a. Perfection Corporation.
      b. Precision Plumbing Products, Inc.
      c. Victaulic Co. of America.
      d. Or equal**.**

2.6 FLEXIBLE CONNECTORS

A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:

   1. NPS 2 and Smaller: Threaded.
   2. NPS 2-1/2 and Larger: Flanged.
   3. Option for NPS 2-1/2 and Larger: Roll-grooved for use with roll-grooved-end-pipe couplings.

B. Manufacturers:

   1. Anamet Inc.
   2. Flex-Hose Co., Inc.
   3. Flexicraft Industries.
   4. Flex-Pression, Ltd.
   5. Flex-Weld, Inc.
   6. Hyspan Precision Products, Inc.
   7. Mercer Rubber Co.
   8. Metraflex, Inc.
   9. Proco Products, Inc.
   10. Unaflex Inc.
   11. Or equal**.**

C. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

D. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

E. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.7 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008inch minimum thickness, black tube.

2.8 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FM approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 250-psig minimum working-pressure rating if fittings are components of high-pressure piping system.

B. Outlet Specialty Fittings:

1. Manufacturers:

   a. Anvil International, Inc.
   b. Central Sprinkler Corp.
   c. National Fittings, Inc.
   d. Shurjoint Piping Products, Inc.
   e. Southwestern Pipe, Inc.
   f. Tyco Fire and Building Products.
   g. Victaulic Co. of America.
   h. Ward Manufacturing.
   i. Or equal**.**

2. Mechanical-T and -Cross Fittings, bushings, reducing couplings: Shall not be used on Campus.
3. Snap-On and Strapless Outlet Fittings: Shall not be used on Campus.

C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or lockinglug inlet and outlet, test valve, and orifice and sight glass.

1. Manufacturers:

   a. Central Sprinkler Corp.
   b. Fire-End and Croker Corp.
   c. Viking Corp.
   d. Victaulic Co. of America.
   e. Or equal**.**

D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

1. Manufacturers:

   a. Elkhart Brass Mfg. Co., Inc.
   b. Fire-End and Croker Corp.
   c. Potter-Roemer; Fire-Protection Div.
   d. Or equal**.**

E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

1. Manufacturers:

a. AGF Manufacturing Co.
b. Central Sprinkler Corp.
c. G/J Innovations, Inc.
d. Triple R Specialty of Ajax, Inc.
e. Or equal**.**

F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

1. Manufacturers:

a. CECA, LLC.
b. Merit.
c. Or equal**.**

2.9 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or CSFM approved, with 175-psig minimum pressure rating. Valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.

B. Gate Valves:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, non-rising stem, operating nut, and flanged ends.
2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with operating wrench, extension rod, locking device, and cast-iron barrel.
3. Manufacturers:

a. McWane, Inc.; Kennedy Valve Div.
b. NIBCO.
c. Stockham.
d. Or equal**.**

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.

1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with roll grooved ends.
3. NPS 3: Ductile-iron body with roll-grooved ends.
4. Manufacturers:

a. NIBCO.

b. Victaulic Co. of America.
c. Or equal**.**

D. Butterfly Valves: Sizes 2 ½" through 6" UL/ FM approved Victaulic or Equal

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or roll grooved ends.

1. Manufacturers:

a. American Cast Iron Pipe Co.; Waterous Co.
b. Central Sprinkler Corp.
c. Clow Valve Co.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Globe Fire Sprinkler Corporation.
g. Hammond Valve.
h. McWane, Inc.; Kennedy Valve Div.
i. Mueller Company.
j. NIBCO.
k. Potter-Roemer; Fire Protection Div.
l. Reliable Automatic Sprinkler Co., Inc.
m. Star Sprinkler Inc., Tyco Fire and Building Products.
n. Stockham.
o. United Brass Works, Inc.
p. Victaulic Co. of America.
q. Watts Industries, Inc.; Water Products Div.
r. Or equal**.**

F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 and Smaller: Bronze body with threaded ends.

a. Manufacturers:

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) NIBCO.
4) United Brass Works, Inc.
5) 5) Or equal**.**

2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

a. Manufacturers:

1) Clow Valve Co.
2) Crane Co.; Crane Valve Group; Crane Valves.
3) Crane Co.; Crane Valve Group; Jenkins Valves.
4) Hammond Valve.

5) Milwaukee Valve Company.
6) Mueller Company.
7) NIBCO.
8) United Brass Works, Inc.
9) Or equal**.**

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, pre-wired, 2-circuit, supervisory switch.
2. NPS 2 and Smaller: Ball valve with bronze body and threaded ends.

a. Manufacturers:

1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America.
4) Or equal.

3. NPS 2-1/2 and Larger: Gate valve with cast- or ductile-iron body; with flanged or grooved ends.

a. Manufacturers:

1) Central Sprinkler Corp.
2) Grinnell Fire Protection.
3) McWane, Inc.; Kennedy Valve Div.
4) Milwaukee Valve Company.
5) NIBCO.
6) Victaulic Co. of America.
7) Or equal.

2.10 SPECIALTY VALVES

A. Sprinkler System Control Valves: UL listed or CSFM approved, cast- or ductile-iron body with flanged or roll-grooved ends, and 175-psig minimum pressure rating. Control valves shall have 300-psig pressure rating if valves are components of high-pressure piping system.

1. Manufacturers:
a. Central Sprinkler Corp.
b. Globe Fire Sprinkler Corporation.
c. Reliable Automatic Sprinkler Co., Inc.
d. Tyco Fire and Building Products.
e. Victaulic Co. of America.
f. Viking Corp.
g. Or equal**.**

2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze roll-grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets

for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

B. Pressure-Regulating Valves: UL 1468, brass or bronze, NPS 2-1/2, 400-psig minimum rating. Include female NPS inlet and outlet, adjustable setting feature, and straight pattern design.
1. Finish: Rough metal.
2. Manufacturers:
a. Elkhart Brass Mfg. Co., Inc.
b. Fire-End and Croker Corp.
c. Grinnell Fire Protection.
d. Potter-Roemer; Fire Protection Div.
e. Zurn Industries, Inc.; Wilkins Div.
f. Or equal**.**

C. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

1. Manufacturers:

a. AFAC Inc.
b. Or equal**.**

2.11 SPRINKLERS

A. Sprinklers shall be UL listed or CSFM approved, with 175-psig minimum pressure rating.

B. Manufacturers:

1. Central Sprinkler Corp.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Star Sprinkler Inc., Tyco Fire and Building Products.
5. Victaulic Co. of America.
6. Viking Corp.
7. Or equal**.**

C. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 199, for nonresidential applications.
2. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Flush ceiling sprinklers, including escutcheon.

3. .
4. Pendent sprinklers.
5. Quick-response sprinklers.
6. Recessed sprinklers, including escutcheon.
7. Sidewall sprinklers.
8. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated in finished areas, bronze in exposed building services areas, and, when approved by the University's Representative, painted.

G. Special Coatings: Provide Teflon-coated sprinklers heads and polished stainless steel escutcheons for exterior and corrosive atmospheres applications.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

J. Extended coverage type sprinklers shall not be used.

2.12 HOSE CONNECTIONS

A. Manufacturers:

1. Central Sprinkler Corp.
2. Elkhart Brass Mfg. Co., Inc.
3. Fire-End and Croker Corp.
4. Fire Protection Products, Inc.
5. Guardian Fire Equipment Incorporated.
6. McWane, Inc.; Kennedy Valve Div.
7. Mueller Company.
8. Potter-Roemer; Fire-Protection Div.
9. United Brass Works, Inc.
10. Or equal**.**

B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
2. Finish: Rough metal.

2.13 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:

1. Central Sprinkler Corp.
2. Elkhart Brass Mfg. Co., Inc.
3. Fire-End and Croker Corp.
4. Fire Protection Products, Inc.
5. Guardian Fire Equipment Incorporated.
6. Potter-Roemer; Fire-Protection Div.
7. Reliable Automatic Sprinkler Co., Inc.
8. United Brass Works, Inc.
9. Or equal**.**

B. Wall-Type, Fire Department Connection

C. Exposed, Freestanding-Type, Fire Department Connection: Four inlet, UL 405, 300-psig minimum pressure rating; with corrosion-resistant-metal body, brass inlets with threads according to NFPA 1963 and matching sizes and threads, and bottom outlet with pipe threads. Include brass lugged caps, gaskets, and brass chains; brass lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high, brass sleeve; and round, floor, brass escutcheon plate with marking "AUTO SPKR & STANDPIPE." Locate FDC per UCR Fire Marshall requirements.

1. Finish Including Sleeve: Polished brass.

2.14 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections and bear UL/FM label and marking and CSFM listing.

B. Electrically Operated Alarm: UL 464, with 10-inch- diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.

1. Manufacturers:

a. Potter Electric Signal Company.
b. System Sensor.
c. Or equal**.**

C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals1.Manufacturers:

a. ADT Security Services, Inc.
b. ITT McDonnell & Miller.
c. Potter Electric Signal Company.
d. System Sensor.

e. Viking Corp.
f. Watts Industries, Inc.; Water Products Div.
g. Or equal**.**

D. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

1. Manufacturers:

a. McWane, Inc.; Kennedy Valve Div.
b. Potter Electric Signal Company.
c. System Sensor.
d. Or equal**.**

2.15 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge.
2. Dresser Equipment Group; Instrument Div.
3. Marsh Bellofram.
4. WIKA Instrument Corporation.
5. Or equal**.**

B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.

1. Water System Piping: Include caption "WATER" on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13, NFPA 14, and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS, GENERAL

A. Shop-weld pipe joints where welded piping is to be used.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications only. Flanges shall not be used below ground.

D. Piping between Fire Department Connections and Check Valves: Galvanized, Schedule 40, steel pipe with threaded ends; Galvanized cast- or malleable-iron threaded fittings; and threaded.] joints.

E. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement**.**

3.5 Groove-less clamp, cut groove pipe and fittings, reducing couplings, bushings, mechanical tees, street elbows or saddle fittings are not acceptable for use on campus.

3.6 STANDPIPE SYSTEM PIPING APPLICATIONS

A. Standard-Pressure, Wet-Type Standpipe System, 175-psig Maximum Working Pressure:

1. NPS 4 and Smaller: ASTM A53, Threaded-end, black, schedule 40, steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
2. NPS 4 and Smaller: ASTM A53, Plain-end, black, schedule 40 or 10, steel pipe; steel welding fittings; and welded joints.
3. NPS 4 and Smaller: Roll-Grooved-end, black, schedule 40 or 10, steel pipe with [roll-grooved ends; roll-grooved-end fittings; roll-grooved-end-pipe couplings; and roll-grooved joints.
4. NPS 5 and NPS 6: Roll-grooved-end, black, schedule 40 or 10, steel pipe with roll-grooved ends; roll-grooved-end fittings; roll-grooved-end-pipe couplings; and roll-grooved joints.
5. NPS 2 ½” through 6” roll grooved schedule 10 black steel pipe

3.7 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:

1. NPS 1-1/2 and Smaller: Threaded-end, black, schedule 40, steel pipe; cast- or malleable iron threaded fittings; and threaded joints.
2. NPS 1-1/2 and Smaller: Plain-end, black, schedule 40, steel pipe; steel welding fittings; and welded joints.
3. NPS 2: Threaded-end, black, schedule 40, steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.

4. NPS 2: Plain-end, black, schedule 40, steel pipe; steel welding fittings; and welded joints.
5. NPS 2: Roll-Grooved-end, black, schedule 40, steel pipe; roll-grooved-end fittings; roll grooved-end-pipe couplings; and roll-grooved joints.
6. NPS 2-1/2 to NPS 3-1/2: Threaded-end, black, schedule 40, steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
7. NPS 2-1/2 to NPS 3-1/2: Plain-end, black, schedule 40, steel pipe; steel welding fittings; and welded joints.
8. NPS 2-1/2 to NPS 3-1/2: Roll-Grooved-end, black, schedule 40 or 10, steel pipe; roll-grooved end fittings; roll-grooved-end-pipe couplings; and roll-grooved joints.
9. NPS 4 to NPS 6: Threaded-end, black, schedule40, steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
10. NPS 4 to NPS 6: Plain-end, black, schedule 40 or 10, steel pipe; steel welding fittings; and welded joints.
11. NPS 4 to NPS 6: Roll-grooved-end, black, schedule 40 or 10, steel pipe; roll-grooved-end fittings; roll-grooved-end-pipe couplings; and roll-grooved joints.

12. NPS 2 ½" to 6" roll-grooved sch 10 back steel pipe

3.8 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Listed Fire-Protection Valves: UL listed and CSFM approved for applications where required by NFPA 13 and NFPA 14

a. Shutoff Duty: Use ball, or straight pattern gate valves. Butterfly valves are not acceptable.

3.9 JOINT CONSTRUCTION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 and Campus Standards for pipe thickness and threads.

Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 to match pipe.

C. Twist-Locked Joints: Shall not be used on Campus.

D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.

E. Mechanically Formed, Copper-Tube-Outlet Joints: Shall not be used.

F. Roll-Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. Steel Pipe: Roll-groove piping as indicated. Use roll-grooved-end fittings and rigid, roll grooved-end-pipe couplings.

2. Copper Tube: Roll-groove tubing. Use roll-grooved-end fittings and roll-grooved-end tube couplings.

G. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.

1. NPS 2 and Smaller: Use dielectric couplings, or nipples.
2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
3. NPS 5 and Larger: Use dielectric flange insulation kits.

3.10 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 22 Section "Facility Water Distribution Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Refer to Division 22 Section "Facility Water Distribution Piping" for backflow preventers.

C. Install 1” relief valve immediately downstream of backflow preventer with an isolation valve and drain to rough grade. Set at 175 PSI.

3.11 PIPING INSTALLATION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from Campus Fire Marshal and University Representative. File written approval with University Representative before deviating from approved working plans.

C. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints. Encase piping in corrosion-protective encasement.

D. Install underground copper service-entrance piping according to NFPA 24. Encase piping in corrosion-protective encasement.

E. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

F. Install sprinkler heads to supply piping via a threaded branch outlet and by a minimum 1-inch by ½-inch threaded, tapered, reducing fitting.

G. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using roll-grooved joints.

H. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections. Flanges shall be installed on aboveground piping only.

I. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

J. Install sprinkler piping with drains for complete system drainage.

K. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes
L. Install 1" drain valves on standpipes with garden hose outlet.

M. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

N. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install standpipe system piping according to NFPA 14.
2. Install sprinkler system piping according to NFPA 13.
3. Beam clamps shall be fitted with steel retainer straps.
4. Hanger rods of less than 3/8 inch diameter are not permitted.
5. Hanger rods in contact with piping are not permitted.
6. Attach rods to concrete with Type 18 insert or drilled expansion anchor.
7. Powder driven or gas driven studs are not permitted.
8. Retrofit hangers shall not be used for new construction.

O. Earthquake Protection: Install piping according to NFPA 13 and ASCE 7.6 and CBC for seismic zone 4 to protect from earthquake damage.

P. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal.

Q. Fill wet-standpipe system piping with water.

R. Fill wet-pipe sprinkler system piping with water.

3.12 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles. For side wider than two (2) feet, ¼ points will be acceptable.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry type sprinklers with water supply from heated space.

3.13 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 .

3.14 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Energize circuits to electrical equipment and devices.
4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
5. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
6. Coordinate with fire alarm tests. Operate as required.
7. Verify that equipment hose threads are same as City of Riverside fire department equipment.

8. Conduct witnessed Standpipe flow test, proving design requirements.

B. Report test results promptly and in writing to University Representative and Campus Fire Marshal.

3.15 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.16 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Sections "Demonstration and Training." and “Closeout Procedures.”

END OF SECTION 21 1000

SECTION 22 0500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing. Provided by other section of work.
10. Concrete bases. Provided by other section of work
11. Firestopping

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic. Not allowed on lab waste per UCR.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

4. PP: Polypropylene plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Piping penetration through fire-rated construction assemblies, including accessory components; sleeves, sealants, packing materials and methods, and installation shall meet the requirements of the CBC, and shall be California State Fire Marshal approved. Firestopping details shall bear the UL label, indicate F-rating, T-rating, and shall meet the requirements of the California Building Code. Recommend all UL systems by one vendor/contractor..

E. Groove-less clamps, cut groove pipe and fittings, reducing couplings, bushings, mechanical tees or saddle fittings are not acceptable for use on campus. Pipe sizes from 2-1/2” and above. 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section 08 3113 "Access Doors and Frames." Coordinate to avoid access panels at hard lid ceiling if possible. Access panel shall be located in accessible area for maintenance convenience and safety and limit disturbance to the public.

D. Coordinate with other sections of the specifications for the applicability of materials specified in this section. Not every product or material listed may be used.

E. Coordinate requirements of this section with actual work to be performed. This section is general in scope for basic materials and methods, all of which may not actually apply to this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer. Review Division 1.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: Bolts shall be United States Customary System bolts and nuts (e.g. ¾"). Metric bolts and nuts shall not be used. Bolts and nuts shall be stainless steel with heavy hex nuts at exterior locations, standard carbon steel on interior locations. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, BCup3 or BCup4, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.

f. Viking Johnson.
g. Or equal.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Eslon Thermoplastics.
b. Or equal.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.
b. Or equal.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.
c. Or equal.

E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.
e. Or equal.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Shall not be used. Provide 6" long brass nipple with brass unions. Or brass union and bronze ball valve on ends of nipple.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.
e. Or equal.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Or equal.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.
c. Or equal.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.
e. Or equal.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Thunderline Modular Seals: Link-seal
f. Or equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop on outside walls below grade, unless otherwise indicated.

D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe: ASTM D 1785, Schedule 40.

F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: Two-piece, deep-pattern type.
b. Chrome-Plated Piping: Two -piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: Two-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Two -piece, cast brass type with polished chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Two-piece, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: Two-piece, cast-brass type with polished chrome-plated finish.
g. Bare Piping in Equipment Rooms: Two-piece, cast-brass type.
h. Bare Piping at Floor Penetrations in Equipment Rooms: Two-piece, floor-plate type.

M. Mounting hardware, including nuts, bolts and washers for outdoor applications and below grade applications must be of stainless steel materials.

N. Sleeves are not required for core-drilled holes, except in L Occupancies and other locations, where spill control is required. Refer to architectural documents for details.

O. Permanent sleeves are not required for holes formed by removable PE sleeves.

1. Install sleeves for pipes passing through interior concrete and masonry walls. Install sleeves in new walls and slabs as new walls and slabs are constructed.

2. Install sleeves that provide code compliant annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6, mechanical rooms and wet area applications, where spill containment is required.

3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section 07 9200 "Joint Sealants" for materials and installation.
4. Sleeve application and installation shall comply with CBC requirements and UL approved Firestopping Details. Refer to Firestopping Sections 07 8413 and 07 8443.
5. Coordinate requirements of sound-proofing caulk, as determined by the Sound and Vibration Consultant's recommendations. Refer to section 22 0548 "Vibration and Seismic Controls for Plumbing.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing galvanized mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section 07 8413 "Penetration Firestopping" for materials. T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

V. Install valves in readily accessible locations, avoiding hard-lid ceilings where possible. Provide access panels for valve access complying with Division 08, and coordinate access panel locations with other disciplines.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Oxyacetylene torch welding, and cutting of structural steel or bolt holes shall not be permissible.

F. Install main and branch piping using specified fittings, “T-drill”, “welded nozzles”, or “SideTap” or similar fitting substitution style connections are not acceptable. T-drill applications..

G. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

I. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

J. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

K. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. PE and PP Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

O. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install shut-off valves at final connection to each piece of equipment.
2. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
3. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
4. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
5. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of plumbing systems, equipment, and components is provided by others under Division 09 Sections "Interior Painting" and "High-Performance Coatings."

3.6 CONCRETE BASES Provided by other section of work.

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Install anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
3. Install anchor bolts to elevations required for proper attachment to supported equipment.
4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

D. Outdoor Applications: Outdoor support assemblies and accessories shall be of “stainless steel material”, or “hot-dip galvanized carbon steel with high-performance coatings”, as noted below:

1. Stainless steel: Mounting hardware such as bolts, nuts, washers, straps, brackets, fastening hardware etc., shall be stainless steel.
2. Coated galvanized steel: Carbon steel support assemblies, including all metal fabrications for use outdoors shall comply with each paragraph listed below:

    a. Assemblies must be shop-fabricated and pre-assembled for one-piece hot-dip galvanized coating process
    b. After hot-dip galvanized coating is applied, a high-performance exterior coating system shall be applied. Provide High-Performance Exterior Coating Systems conforming to Division 09 “High Performance Coatings”, meeting all performance requirements, including salt spray test performance.
    c. Touch-up and repair per manufacturer’s recommendations after field installation.

E. Rooftop Applications: Rooftop support assemblies and accessories shall be fabricated for outdoor applications as noted above, and shall be designed per SMACNA design requirements.

1. SMACNA Clearances: Pipes, pipe racks, and equipment shall be installed high enough above roofing surfaces to allow roofing access for maintenance and repair. Install piping and equipment at a minimum height as shown in Table 4-1 of SMACNA Architectural Sheet Metal Manual – 5th Edition.
2. SMACNA Support Systems: Piping systems and equipment supports, unless otherwise shown, use round column supports to tie-in to structure with lead jacks for built-up roofs, and single-ply preformed jacks for single-ply roofs, lead flashing, and lead umbrellas with stainless steel draw band per Figure 4-16A, or Figure 4-16B, of SMACNA Architectural Sheet Metal Manual – 5th Edition.

3.8 GROUTING

A. Grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors provided by others under Division 03 Section.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 22 0500

SECTION 22 0513 – MOTORS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes basic requirements for factory or field-installed motors.

B. The standards for the motors listed below exceed those commonly found in the commercial plumbing market. This is intentional and shall not be deviated from. Typical campus applications require much longer life in service than typical commercial applications. Many of the applications are 24 hours per day and on variable frequency drives. The various characteristics of high end industrial motors ensure a very long life in campus service and provide significantly increased energy performance. Their rugged construction helps ensure that initial efficiency is maintained over the life of the motor. Improved characteristics such as reduced shaft runout, and foot flatness allow for better alignment between the motor and the driven equipment. This improves efficiency and reduces noise and vibration. C. Related Sections include the following:

1. Division 22 Section 22 0513 "Vibration and Seismic Controls for Plumbing" for mounting motors and vibration isolation and seismic-control devices.
2. Division 23 Section 23 0510 "Variable Frequency Drives" for speed control devices.
3. Division 22 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.2 QUALITY ASSURANCE

A. Source Limitations: If one of the approved manufacturers cannot be provided and factory installed, then a field-installed motors meeting these specifications shall be field installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in California Electrical Code (CEC), Article 100, by a testing agency acceptable to the University, and marked for intended use.

C. Motor Insulation: Insulation shall be inverter-rated Class F, or H, meeting NEMA MG1-2006, Part 31 for inverter duty service with VFD applications. Motor temperature rise shall be kept equal to or below class B standards when operating at full load on sine wave power. The assembled motor insulation system shall resist 2000-volt transients without premature motor failure.

D. Motors shall conform to IEEE Standard 841-2001, IEEE Standard for Petroleum and Chemical Industry - Severe Duty Squirrel Cage Induction Motors.

E. Bearings: Bearing loads and bearing life shall be determined using AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings, and AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:
    a. Magnetic controllers.
    b. Reduced-voltage controllers.
    c. Variable frequency drives.
2. Designed and labeled for use with variable frequency controllers (VFD), and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. U.S. Motors, TEFC 841 Plus.
2. General Electric, X$D Ultra 841.
3. Siemens Motors Medallion
4. Baldor Motors
5. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 MOTOR REQUIREMENTS

A. Do not include motor specification in other sections as this specification shall apply to every motor on the project. Motor requirements apply to factory-installed or field-installed motors except as follows:

1. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified. This specification shall govern with regards to efficiency, enclosure and ruggedness of design. Factory motors shall match these more stringent standards.

2.3 MOTOR CHARACTERISTICS

A. Motors one horsepower and larger: Three-phase.

B. Motors three-quarter horsepower and smaller: Three-phase or Single-phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected. Polyphase-motor installations on less than 460-Volt nominal circuits shall require written permission from the University.

E. Service Factor: 1.15 or more for all motors on sine wave power; 1.0 for motors on inverter power.

F. Duty: "Severe Duty" and "Continuous Duty" at ambient temperature of 105 deg F (40 deg C) and at altitude of 200 feet above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Totally Enclosed Fan Cooled (TEFC); or Totally Enclosed Air Over (special applications only), or Totally Enclosed Not Ventilated (special applications only). Open Drip Proof Motors shall not be used.

2.4 POLYPHASE MOTORS ONE-HALF AND THREE-FOURTH HORSEPOWER

A. Efficiency: Meeting or exceeding EPACT 1992 requirements.

B. Bearings: Sealed

C. Service Factor: 1.25

D. Use: Minimize use of motors in this size range by combining loads.

2.5 POLYPHASE MOTORS ONE HORSEPOWER AND LARGER

A. Description: Premium Efficiency Severe Duty, TEFC, Continuous Duty per NEMA Design B.

B. Efficiency: NEMA Premium Efficiency meeting the Standards of IEEE 841 2001. Guaranteed efficiencies shall not be less than the following:

Minimum Guaranteed Motor Efficiencies Percent				
	Nominal Speed (RPM)			
Horsepower	**3600**	**1800**	**1200**	**900**
1	86.5	85.5	82.5	78.5
1½	86.5	86.5	87.5	78.5
2	85.5	86.5	88.5	85.5
3	88.5	89.5	89.5	85.5
5	89.5	89.5	89.5	88.5
7½	90.2	91.7	91.0	88.5
10	90.2	91.7	91.0	89.5
15	91.0	92.4	91.7	89.5
20	91.7	93.0	91.7	90.2
25	92.4	93.6	93.0	91.7

Notes:
1. Premium Efficiency, Severe Duty, Cast Iron frame mounted motors as specified herein are larger and heavier than corresponding lower quality motors. Ensure that the equipment manufacturers make provision for the size and weight of these energy-saving motors.

C. Stator: Copper windings, Windings shall have “inverter grade insulation” and non-hygroscopic.

D. Rotor: Squirrel cage, Precision balanced to less than 0.08 in/sec vibration. Epoxy coated from bearing journal to bearing journal. Total shaft runout shall not exceed 0.001” for shaft sizes 0.875” to 1.625” and 0.0015” for shaft diameters greater than 1.625”.

E. Bearings: Double-shielded, prelubricated ball bearings on motors smaller than 180-frame. Regreasable bearings on 180-T frame and larger. Size 300 series bearings on 250 T frame and

up. Internal bearing caps on 180 T frame and larger. Where motor shafting will be used to support driven equipment (such as a fan), the manufacturer shall make an analysis of the expected bearing life and provide bearings that will have an L_{10} life of 130,000 hours for directdrive and 50,000 hours for belt-drive.

F. Temperature Rise: Class B rise at full load on sine wave power.

G. Insulation: Class F, unless otherwise indicated.

H. Enclosure: Cast Iron Construction (may use steel mounting base on 140-T frame series). Motor casing shall have exterior fins for surface cooling.

I. Finish: Chemical resistant paint (250-hour salt spray test) over corrosion-resistant primer. Color may be standard factory color or finished to match the architectural color palette.

J. Corrosion resistance: Internal components shall be coated with corrosion preventative material

K. Foot Flatness: Motor base mounting-hole to mounting-hole flatness shall be less than 0.005 inches (five thousandths of an inch or 0.127 millimeter).

L. Motor shall have Inpro/Seal on drive end for IP55 protection and shall have provision for converting opposite end to having such a seal. Inpro seal on both ends is also acceptable.

M. Conduit Boxes: Shall be twice NEMA volume standards minimum and shall be field repositionable to allow ease of conduit connection.

N. Grounding: Shall have external grounding provision

O. Nameplate: Shall be embossed stainless steel and shall include efficiency information.

P. Hardware: Corrosion resistant SAE Grade-5.

Q. Breather plug: Shall be fitted with brass breather plug.

R. Compatibility with Inverter Service: Shall be able to operate at 10:1 variable torque and 5:1 constant torque on inverter power.

S. Speed: Motors may be eight-pole, six-pole, or four-pole. Two-pole motors (3600-rpm synchronous speed) may be used only with written permission of the University.

T. Warranty: Warrantee shall be for 60 months from the date of installation or 66 months from the date of shipment from the motor factory.

2.6 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.
2. Temperature Rise: Matched to rating for Class B insulation.
3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Motors connected to variable frequency controllers shall have shaft grounding devices meeting the following requirements:

1. Manufacturer: AEGIS SGR™ Bearing Protection Rings manufactured by Electro Static Technology (EST).
2. Shaft grounding shall be a bearing isolator, or labyrinth seal, that includes a built-in grounding ring and brush. The brush shall contain conductive microfibers that surround the shaft to discharge any current flowing through it.
3. Motors less than 100 HP size shall be provided with a single shaft grounding ring provided on the drive end of the motor.
4. Apply a fast drying silver paint on the shaft surface to prevent corrosion.
5. Shaft grounding ring wear shall be less than 0.001" in 10,000 hours with a fiber wear length designed for expected life 200,000+ hours based on testing. Shaft grounding rings shall be compatible with operating environments ranging from -40° F (-40° C) to 300° F (150° C) and 0-90% RH (non-condensing).

2.7 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align motor with base.

B. Comply with mounting and anchoring requirements specified in Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing."

C. Connect motor leads to power source using rings and bolts or split bolts as needed. Insulation of connected motor leads shall be of the highest quality and designed to withstand the same temperature as the internal windings. Ordinary electrical tape is not generally suitable for this service and shall not be used as the only means of insulation. Wire nuts shall not be used. D. Motor power leads shall be marked at the source and at the connection box on the motor.

3.3 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
2. Test interlocks and control features for proper operation.
3. Verify that current in each phase is within nameplate rating.

B. Testing: University’s Representative may engage a qualified testing agency to perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1 and certify compliance with test parameters.

C. After the University's testing agency is finished, correct any malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and the University shall retest.

3.4 ADJUSTING

A. Align motors and bases.

3.5 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 22 0513

SECTION 22 0516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following pipe expansion joints and expansion compensation devices for mechanical piping systems:

1. Metal-bellows expansion joints.
2. Expansion compensators.
3. Rubber expansion joints.
4. Flexible-hose expansion joints.
5. Packed slip expansion joints.
6. Seismic flexible hose joints.
7. Pipe bends and loops.

1.2 DEFINITIONS

A. BR: Butyl rubber.

B. Buna-N: Nitrile rubber.

C. CR: Chlorosulfonated polyethylene synthetic rubber.

D. CSM: Chlorosulfonyl-polyethylene rubber.

E. EPDM: Ethylene-propylene-diene terpolymer rubber.

F. NR: Natural rubber.

G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

A. Product Data: For each type of pipe expansion joint and alignment guide indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.

2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Schedule: Indicate type, manufacturer's number, size, material, temperature, pressure rating, end connections, and location for each expansion joint.

C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

D. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel." 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

B. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage support loads, and vertical loads applied to building structures and structural components shall be reviewed, analyzed, and subject to approval by the project structural engineer of record.

Flexible pipe connectors and expansion joints shall be rated for 150% of design maximum working pressure, or as recommended by the product ManufacturerPART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 EXPANSION JOINTS

A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.

1. Manufacturers:

a. Adsco Manufacturing, LLC.
b. Ebba Iron Sales
c. Flex-Hose Co., Inc.
d. Flexicraft Industries.
e. Hyspan Precision Products, Inc.
f. Metraflex, Inc.
g. Or equal.

2. Metal-Bellows Expansion Joints for Copper Piping: Single- or multiple -ply phosphorbronze bellows, copper pipe end connections, and brass shrouds.
3. Metal-Bellows Expansion Joints for Steel Piping: Single- or multiple -ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.
4. Minimum Pressure Rating: 175 psig at 200°F., unless otherwise indicated.
5. Configuration: Single- or double -bellows type, unless otherwise indicated.
6. End Connections: Flanged or weld.

B. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

1. Manufacturers:
    a. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. Ebba Iron Sales
    d. Garlock Sealing Technologies.
    e. Mason Industries, Inc.; Mercer Rubber Co.
    f. Metraflex, Inc.
    g. Or equal.
2. Arch Type: Multiple arches.
3. Spherical Type: Multiple spheres.
    a. Minimum Pressure and Temperature Ratings for NPS 1-1/2 to NPS 4: 150 psig at 220°F.
    b. Minimum Pressure and Temperature Ratings for NPS 5 and larger: 150 psig at 200°F.
4. Material: EPDM, with polyester or nylon reinforcement fabric cord.
5. End Connections: Full-faced, integral, class 150, steel flanges with steel retaining rings.

C. Flexible-Hose Expansion Joints and Assemblies: Flexible hose construction with inner hose and outer sheath, provide hose assemblies in pairs to allow for vertical and horizontal motion.

1. Manufacturers:
    a. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. Metraflex, Inc.
    d. Or equal.
2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder joint or threaded end connections.
    a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

4. Flexible-Hose Expansion Assembly: Manufactured assembly with two flexible-metalhose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.

a. Configuration: Pre-assembled unit with flanged connections, stainless steel hoses and double braid stainless steel sheaths.
b. Temperature Rating: 180 psig at 200 degrees F.
c. Design Basis: Flex Hose Company – Tri-flex loop.
d. Angular deflection for NPS 10 and larger: 10 degree minimum

2.4 MATERIALS FOR ANCHORS

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.

1. Stud: Threaded, zinc-coated carbon steel.
2. Expansion Plug: Zinc-coated steel.
3. Washer and Nut: Zinc-coated steel.

E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened Portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
3. Washer and Nut: Zinc-coated steel.

F. Concrete: Refer to Division 03 Section "Cast-in Place Concrete" for formwork, reinforcement, and concrete.

G. Grout: Refer to Division 03 Section for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to Fluid Sealing Assoc's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors" and manufacturers installation instructions.

B. Install expansion joints of sizes matching size of piping in which they are installed.

C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

A. Attach pipe bends and loops to anchors.

1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

B. Pipe bends and loops for high pressure steam-temperature water system shall be of one continuous piece of pipe, welded at each end.

3.5 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

3.6 SEISMIC JOINTS

A. Install Seismic Joints according to the requirements of CBC Seismic Zone 4, and Project Geotechnical Reports.

B. Install seismic joints of sizes matching size of pipe in which they are installed.

C. Seismic joints shall be flexible stainless steel hose type, or double ball joint type.

D. Provide shut-off valve on main pipe side of seismic joint installations to isolate failed joints, allowing the system(s) to stay in service.

E. Install seismic joints in all piping including plumbing, HVAC, and fire protection.

F. Ensure maintenance accessibility of seismic joints.

3.7 ROOFTOP AND OUTDOOR APPLICATIONS

A. Outdoor assemblies shall be fully weather-proof design and installation:

1. Stainless steel: Mounting hardware such as bolts, nuts, washers, anchors straps, brackets, fastening hardware etc., shall be stainless steel.
2. Coated galvanized steel: Exposed product and device materials shall be of stainless steel fabrication, or if not available from the manufacturer in stainless steel, shall be hotdipped galvanized steel with the addition of a high-performance coating conforming to Division 09 “High-Performance Coatings.

B. Piping and equipment shall be supported high enough above roofing surfaces to allow roofing access for maintenance and repair. Install pipes, pipeways, and equipment at a minimum height as shown in Table 4-1 of SMACNA Architectural Sheet Metal Manual – 5th Edition.

END OF SECTION 22 0516

SECTION 22 0519 - METERS AND GAGES FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following meters and gages for mechanical systems:

1. Thermometers.
2. Gages.
3. Test plugs.
4. Water meters

B. Related Sections include the following:

1. Division 22 Section "Natural Gas Piping" for gas meters inside or outside the building.
2. Division 22 Section "Natural Gas Piping" for gas meters inside the building.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for water meter, thermometers, and gages indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of water meter, thermometer, and gage signed by product manufacturer.

D. Operation and Maintenance Data: For water meter to include in emergency, operation, and maintenance manuals.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 DIAL THERMOMETERS

A. Manufacturers

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
6. 3D Instruments
7. Or equal.

B. Bimetallic-Actuated

1. Description: Adjustable angle, Direct-mounting, bi-metallic-actuated dial thermometers complying with ASME B40.3.
2. Case: Liquid-filled type, Stainless steel with 5-inch diameter.
3. Element: Bimetal coil.
4. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
5. Pointer: Black metal.
6. Window: Glass.
7. Ring: Stainless steel.
8. Connector: Adjustable angle.
9. Stem: stainless steel, for thermowells installation and of length to suit installation.
10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range. Scale shall be degrees Fahrenheit, unless otherwise indicated, suitable for the media operating temperatures.

2.3 THERMOWELLS

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. 3D Instruments
6. Or equal.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

C. Characteristics:

1. Threaded Stainless Steel
2. Pressure Rating – not less than piping system design pressure.
3. Stem Length – Extend 2" into fluid or to extend to center of pipe
4. Extension for insulated piping –2" nominal but not less than thickness of insulation
5. Threaded cap nut – With chain permanently fastened to well and cap.

2.4 PRESSURE GAGES

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. 3D Instruments
6. Or equal.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type, complying with ASME B40.100. Provide shutoff valve with pressure gauge. Shall be equal to Trerice 700 Series.

1. Case: Dry and Liquid-filled type (glycerine or other), 4 or 4-1/2-inch diameter, stainless steel case.
2. Pressure-Element Assembly: Phosphor bronze bourdon tube, brass socket.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type, unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Aluminum, white background with black graduations and markings.
6. Pointer: Black metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Accuracy: Grade 1A, plus or minus 1 percent full scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.
12. Scale: Scale shall be psig or inches mercury vacuum depending on the application.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass, or equal gauge cock type or stainless-steel ball type by Apollo.
2. Siphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

A. Manufacturers

1. Peterson Equipment Co., Inc.

2. Sisco Manufacturing Co.
3. Trerice, H. O. Co.
4. Or equal.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem beyond insulation for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing neoprene, valves gasketed orifice, suitable for inserting a 1/8" OD probe assembly.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

2.6 WATER METERS

A. Manufacturers

1. Master Meter, Inc.
2. ABB Water Meters, Inc.
3. Metron-Farnier
4. Badger Meter, Inc.
5. Schlumberger Limited; Water Div.
6. Sensus Technologies, Inc.
7. Or equal.

B. Provide the following type of water meters based on the capacity required:

Device Size/Type	Low Flow Accuracy >95%	Intermittent Flow per AWWA	Continuous Flow	Head Loss at Intermittent Flow (psi)
2"/PD	8	160	80	12.1
2"/turbo	4	200	160	6.5
3"/turbo	5	450	350	7.1
4"/turbo	15	1250	1000	6.3
6"/ultrasonic	3 at +5%	2000 short term deluge flow	1600	0.69

C. Description: AWWA C701, turbine or ultrasonic type for 1-1/2"and larger meter size. Register flow in cubic feet.

D. Data-Acquisition Units: Comply with University's requirements for connection to Siemens or building data acquisition system. Include meter with signal-transmitting assembly for connection to low-voltage connecting wiring.

E. Intermittent Flow is that flow that can be sustained approximately 1 hour per day seven days a week. Continuous is 24 hours a day seven days a week.

2.7 FLOW INDICATORS

A. Manufacturers

1. Brooks Instrument Div.; Emerson Electric Co.
2. Dwyer Instruments, Inc.
3. Ernst Flow Industries, Inc.
4. Penberthy, Inc.
5. Or equal.

B. Description: Instrument for installation in piping systems for visual verification of flow.

C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.

D. Pressure Rating: 125 psig

E. Temperature Rating: 200 deg F

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install bimetallic-actuated dial thermometers in the following locations:

1. Inlet and outlet of each domestic heat exchanger.
2. Inlet and outlet of domestic and industrial water heaters and in recirculation return pipe.

B. Install bimetallic-actuated dial thermometers at suction or discharge of each pump.

C. Mercury thermometers shall not be used.

D. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for inlet and discharge of each pressure-reducing valve.

B. Install bi-metal -type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending a minimum of 2 inches into fluid or to the center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

D. Install ball valve and snubber fitting in piping for each pressure gage for fluids.

E. Install test plugs in tees in piping.

F. Install flow indicators, in accessible positions for easy viewing, in piping systems.

G. Water meters for domestic water shall be located inside the building in mechanical room in an accessible location and approximately 3’-0” from the floor. Provide a bypass and a lockable shut-off valve around water meter and label “Normally Closed”. Provide a strainer upstream of the meter and shutoff valves on each side of the meter to allow removal while water service is in operation using the bypass.

H. Install permanent indicators on walls or brackets in accessible and readable positions.

I. Install connection fittings for attachment to portable indicators in accessible locations.

J. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

B. Ground equipment scope by others. Refer to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring scope by others. Refer to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 ADJUSTING

A.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.6 CLEANING

A. Clean windows of meters, and gages, and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.

END OF SECTION 22 0519

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section 05 5000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 22 Section 22 0516 "Expansion Fittings and Loops for Plumbing" for pipe guides and anchors.
3. Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing" for vibration isolation devices.
4. Division 22, Section 22 0500 “Common Work Results for Plumbing” for piping, equipment, materials and installation.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports shop drawing for piping and equipment in accordance with CBC for seismic zone 4.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Pipe positioning systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

B. Seismic Engineering: Seismic bracing and support design, mounting hardware and equipment, support systems, restraint systems, anchorage systems, and installation shall conform to the CBC requirements for Seismic Zone 4. Submit calculations, plans, and documents stamped by a qualified California registered engineer.

C. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage and support loads, and vertical loads applied to building structures and structural components shall be reviewed, analyzed, and approved by the project structural engineer of record.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Grinnell Corp.
3. ERICO/Michigan Hanger Co.
4. Globe Pipe Hanger Products, Inc.
5. Grinnell Corp.
6. Tolco Inc.
7. Superstrut
8. Or equal.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. Power-Strut Div.; Tyco International, Ltd.
4. Tolco Inc.
5. Unistrut Corp.; Tyco International, Ltd.
6. Or equal.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psigminimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. ERICO/Michigan Hanger Co.
2. PHS Industries, Inc.
3. Pipe Shields, Inc.
4. Or equal.

C.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Shall not be used.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated, except exterior or corrosive environments shall be stainless steel, for use in hardened portland cement concrete with pullout, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Hilti, Inc.
c. ITW Ramset/Red Head.
d. Powers Fasteners.
e. Or equal.

C. Concrete Inserts: Carbon steel, electro-galvanized, except exterior or corrosive environments shall be stainless steel, for use in hardened portland cement concrete with pull-out, tension, and

shear capacities appropriate for supported loads and building materials where used. UL listed for use in metal deck formed concrete and formed slabs for pre-positioning and attaching hanger rods in poured concrete decks. Suitable for seismic loads and brace attachments.

1. Manufacturers:

    a. B-Line Systems, Inc.; a division of Cooper Industries.
    b. ISAT (Blue Banger Hanger).
    c. Simpson Strong-Tie Company (Blue Banger Hanger).
    d. NIBCO Inc.; Tolco.
    e. Or equal.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosionresistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

    a. ERICO/Michigan Hanger Co.
    b. MIRO Industries.
    c. Or equal.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:

    a. MIRO Industries.
    b. Or equal.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

    a. ERICO/Michigan Hanger Co.
    b. MIRO Industries.
    c. Portable Pipe Hangers.
    d. Or equal.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuousthread rods.

4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainlesssteel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers:

a. Portable Pipe Hangers.
b. Or equal.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.8 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Manufacturers:

1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.
4. Or equal.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 12.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 12, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 12, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 12, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow offcenter closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 12.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 12, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 12, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 12.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 12, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 180 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 180 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel Ibeams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel Ibeams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.

b. Medium (MSS Type 32): 1500 lb.
c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors attachments if concrete insert is not available in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Flexible connection located in horizontal piping shall be supported within 2 feet of each connector.

C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section 22 4000 "Plumbing Fixtures" for plumbing fixtures.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L.

M. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

P. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

2. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

a.
b. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight distribution plate for pipe NPS 4and larger if pipe is installed on rollers.

3.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 4: 12 inches long and 0.048 inch thick.
b. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
c. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

5. Pipes NPS 8and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

Q. Hangers shall not be in direct contact with the pipe.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING Provided by other section of work.

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections**.**

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 ROOFTOP AND OUTDOOR APPLICATIONS

A. Outdoor assemblies shall be fully weather-proof design and installation. Mounting hardware such as bolts, nuts, washers, anchors straps, brackets, fastening hardware etc., shall be galvanized steel or stainless steel.

END OF SECTION 22 0529

SECTION 22 0548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Elastomeric isolation pads and mounts.
2. Restrained elastomeric isolation mounts.
3. Restrained spring isolators.
4. Housed spring mounts.
5. Elastomeric hangers.
6. Spring hangers.
7. Spring hangers with vertical-limit stops.
8. Thrust limits.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Restrained vibration isolation roof-curb rails.
12. Seismic snubbers.
13. Restraining cables.

B. Related Sections include the following:

1. Division 22 Section 22 0516 “Expansion Fittings and Loops for Plumbing” for flexible piping connectors.

1.2 DEFINITIONS

A. Z: seismic zone factor.

1.3 PERFORMANCE REQUIREMENTS

A. Conformance with the California Building Code seismic restraint requirements for seismic zone-4.

B. Z: 0.40

C. Component Seismic Coefficient: shall be per CBC Table 16-Q and the soil profile type for the site.

D. Seismic Importance Factor: 1.25 for anchorage of machinery and equipment required for life-safety systems, 1.0 for other equipment. Life-safety systems would include air-handling units and exhaust fans serving stairwell pressurization fans or laboratories.

E. Component Response Modification Factor: shall be per CBC Table 16-O for the respective nonstructural components and equipment.

F. Component Amplification Factor: Shall be per CBC Table 16-O for the respective nonstructural components and equipment.

G. Sound and Vibration Performance: The Design-Build Team shall retain a licensed professional acoustical engineer for acoustic and vibration analysis and design. All systems shall be reviewed by the acoustical engineer for compliance with acoustics and vibration control contract document requirements. Provide acoustic and vibration design solutions, including system modifications, equipment modifications, additional sound treatment devices, all materials and devices, and all labor per the acoustical engineer's design solution reports, and recommendations.

H. All rotating and reciprocating equipment shall be statically and dynamically balanced to meet the following vibration limits under all design operating conditions and under specified vibration isolation:

Equipment Type	Vibration Limit (inches/sec, RMS)
Pumps	0.1
Reciprocating Equipment	0.4
All Other Equipment	0.1

1. These vibration limits apply either on the bearings or the equipment support structure, whichever applicable.
2. The vibration limits shall include the effects of inertia mass or inertia bases, where applicable.
3. Equipment with variable frequency drives shall meet these limits throughout the entire frequency range that the equipment will operate.

I. Vibration Isolated Equipment with Variable Frequency Drives (VFD) shall not be operated below the following rotational speeds:

Specified Isolation Minimum Static Deflection	Minimum Allowed Equipment Rotational Speed (rpm)
Less than 1 inch	600
1 inch	500
2 inches	400
3 inches	350
4 inches	300
5 or more inches	250

1.4 SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.

1. Manufacturer's model number for each vibration isolator, the equipment or pipeline to which it is to be attached, and the number of isolators to be furnished for each installed system.
2. For steel spring mounts or hangers - free height, deflected height, solid height, isolator loading, and diameter of spring coil.
3. For neoprene isolators - free height, deflected height, and isolator loading.
4. An itemized list of all isolated equipment with detailed schedules showing isolators proposed for each piece of equipment, referencing materials and drawings.

B. Shop Drawings: Signed and sealed by a qualified California registered professional engineer. Include the following:

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

    a. Show base construction for equipment; include dimensions, structural member sizes and support point locations.
    b. Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.

4. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

    a. For seismic slack cables - indicated method to achieve vertical restraint.

5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
6. Layout Drawings showing locations and sizes of braces for suspended piping.

C. Welding certificates.

D. Manufacturer’s Certification: Upon completion of installation, submit written certification from equipment manufacturer that vibration isolation and seismic control devices are installed correctly and properly adjusted.

1.5 QUALITY ASSURANCE

A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to CBC or shall bear anchorage pre-approval "OPA" number, from OSHPD or another agency acceptable to University's Representative, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified California registered professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.

B. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage loads, and all vertical loads applied to the building structure shall be approved by the project structural engineer of record.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section 07 7200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corp.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.
5. Vibration Mountings & Controls/Korfund.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation Co., Inc.
8. ISAT-Internal Seismic Applications Technology, a Division of Tomarco Contractor Specialties
9. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 VIBRATION ISOLATORS

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. California Dynamics Corp.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.
5. Vibration Mountings & Controls/Korfund.
6. ISAT-Internal Seismic Applications Technology, a Division of Tomarco Contractor Specialties

7. Or equal.

B. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
2. Durometer Rating: 50 or 60.
3. Number of Layers: As required. Use multiple layers, separated by steel shims, depending on supported equipment load. See manufacturer's data for load capacities.
4. Based on Mason SWM.

C. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Durometer Rating: 50 or 60.
2. Based on Mason ND.

D. Restrained Elastomeric Mounts: All-directional elastomeric mountings with seismic restraint.

1. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to AASHTO M251, the standard for bridge-bearing neoprene.
3. Based on Mason BR.

E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
7. Based on Mason SLF (or) SLFH.

F. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color code or otherwise identify to indicate capacity range.

1. Based on Mason HD.

G. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene, two elements.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Based on Mason PC30N.

H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
8. Based on Mason WBI (or) WBD.

I. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene or rubber. Include steel and

neoprene or rubber vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

1. Based on Mason ADA (or) ADAH.
2. Based on Mason VSG (or) VSGH.

2.3 SEISMIC-RESTRAINT DEVICES

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
3. California Dynamics Corp.
4. Kinetics Noise Control, Inc.
5. Mason Industries, Inc.
6. TOLCO Incorporated.
7. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
8. Vibration Eliminator Co., Inc.
9. Vibration Isolation Co., Inc.
10. Vibration Mountings & Controls/Korfund.
11. ISAT-Internal Seismic Applications Technology, a Division of Tomarco Contractor Specialties
12. Or equal.

B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 60, plus or minus 5, with a flat washer face.

1. Based on Mason HG.

C. Seismic Snubbers: All directional and factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 60, plus or minus 5.
3. Snubbers, and snubber quantities, shall be selected based upon calculation of forces/loads.
4. Based on Mason Z-1225, or Z-1011.

D. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

1. Based on Mason SCB/SCBH.

E. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.5 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be electrogalvanized. Exception: Hot-dip galvanized metal components for exterior use or within tunnels, trenches or mechanical rooms containing high temperature water or steam systems.
3. Nuts, bolts, and washers for outdoor use or wet applications shall be stainless steel.
4. Baked enamel for metal components on isolators for interior use.
5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install equipment supports, and roof penetrations as specified in Division 07 Section 07 7100 "Roof Accessories."

B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

C. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure. Seismic snubbers shall be as follows:

1. Equipment weighing less than 2400 pounds – Snubber shall be based on Mason Z-1225.
2. Equipment weighing greater than 2400 pounds – Snubber shall be based on Mason Z1011.
3. Snubbers, and snubber quantities, shall be selected based upon calculation of forces/loads.

D. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

E. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods. F. Install resilient bolt isolation washers on equipment anchor bolts.

G. Seismic restraint systems shall be installed in strict accordance with the manufacturer's seismic restraint guidelines manual and all certified submittal data.

H. Branch lines may not be used to restrain main lines.

I. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent piping.

J. Do not brace a system to two independent structures such as ceiling and wall.

K. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

L. Installation of seismic restraints shall not cause any change in position of equipment or piping, resulting in stresses or misalignment.

M. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.

N. Additional Seismic devices, mounts, and equipment bases shall be installed, type of device shall be selected by licensed structural engineer, or licensed acoustical engineer as required to meet project requirements.

O. Provide seismic joints in piping crossing building seismic joints.

3.4 PIPING ISOLATION

A. Piping Hangers: Mason PC30N spring isolator type hangers with minimum 1" deflection (see exception in item "D" below) shall be provided for the following, as determined by the Acoustics and Vibration Consultant.

1. All pipes 1 ¼" and 1 ½" in diameter or pipe racks with equivalent pipe diameter 4" through 9".

B. The first three piping hanger supports from the isolated equipment shall have Mason PC30N isolators with deflection distance matching the deflection distance of equipment mounted springs.

C. Piping suspended with vibration isolators, shall only be with braced with cable bracing. Cabling shall be adjustable and shall not be in tension.

D. Provide seismic joints in piping crossing building seismic joints.

3.5 EQUIPMENT ISOLATION

A. Install piping and electrical flexible connections to externally vibration-isolated equipment.

B. Flexible connectors shall be used to connect all piping to isolated equipment, except equipment for which flexible connectors are not permitted by code.

C. Flexible pipe equipment connectors for all externally isolated equipment shall be as follows:

1. Spherical rubber expansion joints.
2. Flexible hose joints.
3. Locate isolation device downstream of shut-off valves.

D. Flexible pipe equipment connectors for all internally isolated equipment shall be as follows:

1. Double-ply stainless steel bellows without braided jackets.
2. Stainless steel corrugated hose, stainless steel sheath, with metal connectors with minimum specified live lengths. Hose type flexible connectors shall have minimum live lengths as specified in the 1999 ASHRAE Handbook, Table 46 (see below).

Nominal Diameter (inches)	Minimum Live Length (inches)
0.75	12
1	12
1.5	12
2	12
2.5	12
3	18
4	18
5	24
6	24
8	24
10	24
12	36

E. Equipment Isolators: For equipment larger than 0.5 horsepower, use spring isolation device. For equipment smaller than 0.5 horsepower, use neoprene isolation device. F. Install flex connections in parallel with motor shaft. Schedule below applies where motors are not provided with isolators by equipment manufacturers.

G. Equipment Isolation Schedule:

Mark	**Motor Hp**	**Equipment RPM**	**VFD**	**Inertia Base Type**	**Isolator Type**	**Hot-Dip Galvanized**	**Static Deflection (inches)**	**Comments**
DI-1AB	7.5	3800	Yes	Mason M	Mason SLF	Yes	1	Booster Pumps skid mounted
RW-2AB	7.5	3300	Yes	Mason M	Mason SLF	Yes	1	Booster Pumps skid mounted

3.7 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. Isolator seismic-restraint clearance.
2. Isolator deflection.
3. Snubber minimum clearances.

3.8 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

D. Adjust active height of spring isolators.

E. Adjust snubbers according to manufacturer's written recommendations.

F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

G. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.9 CLEANING

A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION 22 0548

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates
2. Equipment markers
3. Equipment signs
4. Access panel and door markers
5. Pipe markers
6. Stencils
7. Valve tags
8. Valve schedules/chart
9. Warning tags
10. Control Devices and instruments

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Valve Numbering Scheme. Provide hard-copy and electronic spreadsheet of valve schedule covering all valve tags. Coordinate numbering scheme prior to submittal.

D. System Drawings: Furnish plans indicating valve numbers and equipment identification numbers/ tags as identified in electronic spreadsheet.

1.3 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

B. NFPA Compliance: Comply with requirements of NFPA-99.... for piping and equipment labeling and identification.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied. Painting scope under another division of work.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal or plastic, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent epoxy adhesive or rivets.

1. Terminology: Match schedules as closely as possible.
2. Data:
    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, white surface, black phenolic core, with black melamine subcore. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: 1/8 inch.
4. Provide signs on equipment that is automatically started to comply with CAL-OSHA requirements.
5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise approved.
2. Lettering: Use piping system terms and abbreviations as approved by the University’s Representative.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.

4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, acrylic enamel black. Paint may be in pressurized spraycan form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2inch numbers, with numbering scheme approved by the University. Provide 5/32-inch hole for fastener.

1. Material: 0.040-inch- thick brass minimum 2” in diameter.
2. Valve-Tag Fasteners: Stainless steel or brass chain, or S-hook.

2.6 VALVE PLANS

A. Valve Plans: For each piping system, provide electronic and hard copy on standard-size or 11”x17” bond paper. Provide a plan per floor showing the location, valve number, control

device number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

2.8 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Seton Identification Products.
3. R&R Identification Co.
4. Or equal.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate nor has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible.

B. Install equipment markers with screws or permanent adhesive on or near each major item of plumbing equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering

for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warning of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Meters and similar units.
    c. Fuel-burning units, including water heaters
    d. Pumps, compressors and similar motor-driven units.
    e. Heat exchangers, water heaters and other similar equipment.
    f. Tanks and pressure vessels.
    g. Water-treatment systems, and similar equipment.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with equipment markers in the following color codes:

    a. Brown: For energy-reclamation equipment and components.

2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Fuel-burning units, including boilers, water heaters.
    c. Pumps, compressors and similar motor-driven units.
    d. Heat exchangers and similar equipment.
    e. Tanks and pressure vessels.
    f. Water-treatment systems, and similar equipment.

D. Install access panel markers with screws or permanent adhesive on equipment access panels.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
3. Do not use pipe markers and tapes for bare pipes conveying fluids at temperatures of 125 deg F or higher.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. At access doors, manholes, and similar access points that permit view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 25 feet along each run.

3.4 VALVE-TAG INSTALLATION

A. Install tags on all valves (all types) and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule. Install tags on valves such that they will not interfere with the valve operation and maintenance.

B. Valve-Tag Application Schedule:

1. Information:

a. Service.
b. Floor.
c. Valve number.
d. Area served.
e. Normal position.
f. Duty.
g. Type (if not obvious).

2. Valve-Tag Size and Shape:

a. 2 inches, round.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 ADJUSTING

A. Relocate plumbing identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

A. Clean faces of plumbing identification devices.

END OF SECTION 22 0553

SECTION 22 0700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field applied jackets; accessories and attachments; and sealing compounds for new and existing affected by work of this project for Plumbing piping systems.

B. This Section includes blanket, board, and block insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds C. Related Sections include the following:

1. Division 07 Section 07 8413 "Penetration Fire stopping" for fire stopping materials and requirements for penetrations through fire and smoke barriers.
2. Division 22 Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe insulation shields and protection saddles.
3. Division 23 Section 23 2110 "Hydronic Distribution" for loose-fill pipe insulation in underground piping outside the building.

1.2 SUBMITTALS

A. Product Data: Identify thermal conductivity, R-value, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. LEED Submittal:

1. Product Data for LEED-NC Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings: Show fabrication and installation details for the following:

1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
2. Insulation application at pipe expansion joints for each type of insulation.
3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Removable insulation at piping specialties and equipment connections.
5. Application of field-applied jackets.
6. Field application for each equipment type.
7. Removable insulation sections at access panels.
8. Application of field-applied jackets.
9. Special shapes for cellular-glass insulation.

D. Samples: For each type of insulation and jacket. Identify each Sample, describing product and intended use. Submit Samples in the following sizes:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Sheet Form Insulation Materials: 12 inches square.
3. Jacket Materials: 12 inches long by NPS 2.
4. Manufacturer's Color Charts: Show the full range of colors available for each type of field-applied finish material indicated.

E. Material Test Reports: From a qualified testing agency acceptable to The University indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

F. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to The University. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for insulation application.

1.6 SCHEDULING

A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mineral-Fiber Insulation:

a. CertainTeed Corp. Crimp Wrap.
b. Johns Manville; Micro-Lok and Micro-Flex.
c. Knauf Insulation; 1000 (Pipe and Tank Insulation).
d. Manson Insulation Inc.; Alley-K and AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.
f. Or equal.

2. Calcium Silicate Insulation:

a. Industrial Insulation Group (The); Thermo-12 Gold.
b. Or equal.

2.2 INSULATION MATERIALS

A. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials, for applications above minus 70 deg F and below 220 deg F.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

B. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all purpose, vapor-retarder jacket.
2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

a. Class 1, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.

7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

C. Calcium Silicate Insulation: Preformed pipe sections of noncombustible, inorganic, hydrous calcium silicate with a nonasbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

D. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.4 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant Kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White.

D. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil- thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

E. Aluminum Piping Jacket: Aluminum roll stock, ready for shop or field cutting and conforming to indicated size. Comply with ASTM B 209, 3003 alloy, H-14 temper.

1. Finish and Thickness: Stucco-embossed finish, 0.024 inch thick.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and Kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, and thickness as jacket. Finish shall be smooth.

F. Aluminum Equipment Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness and corrugation dimensions are scheduled at the end of this Section.

1. Jacket thickness: 0.024 inch
2. Corrugation Dimension: 1-1/4” x ¼”
3. Finish: Stucco-embossed or corrugated finish.
4. Moisture Barrier: 3-mil- thick, heat-bonded polyethylene and kraft paper.

2.5 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd..

1. Tape Width: 4 inches.

B. Bands: 3/4-inch-wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, 240Am 240M, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.
4. Brass: 0. ASTM B209, Alloy 3003, Temper H-14, 0.020" thick, ¾" wide.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel

2.6 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.
g. Or equal.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. No insulation shall be applied to piping until all pressure tests and leak tests are complete, leaks repaired, and the system is successfully tested.

B. Insulation shall be installed in accordance with manufacturer's recommendations, except as otherwise specified.

C. Pipe insulation shall be continuous through the pipe hangers with dense inserts and rated walls.

D. Exposed insulation in tunnels, mechanical or machine rooms or other spaces were insulation could be damaged shall be protected with aluminum jacket to level of 10 feet above finished floor or walkway.

E. Cover elbows and fittings with aluminum jacket where a straight length of piping is also required to have aluminum jacket.

F. Insulation inserts for elbows and fittings shall have same thermal resistance (R) value as pipe insulation.

G. "Raw" ends of insulation shall be sealed.

H. Drain Systems: Insulate roof and overflow drain sumps. Insulate first ten feet of horizontal piping, fittings and traps serving roof/overflow drains, and drain receptors receiving cold condensate.

I. Apply insulation materials, accessories, and finishes per the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

J. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

K. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

L.

M. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

N. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

O. Keep insulation materials dry during application and finishing.

P. Do not use wire outside of jackets.

Q. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

R. Apply insulation with the least number of joints practical.

V. Apply insulation over fittings, valves, and specialties, with continuous thermal and vaporretarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

W. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

X. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

Y. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

Z. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

AA. Install vapor-retarder mastic on equipment scheduled to receive vapor retarders. Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

BB. Provide removable insulation blanket covers on all un-insulated parts of boilers, heaters, heat exchangers, tanks, etc., that could accidentally be touched and cause a burn to maintenance staff.

CC. Insulate the following indoor equipment:

1. Domestic hot-water heaters, heat exchangers and/or storage tanks, not factory insulated.

DD. Equipment Accessibility: Provide removable insulation and jacketing for equipment maintenance access requirements, such as removable heat exchanger head covers and for chilled water equipment testing labels and stamps, etc.

EE. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches on center.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

FF. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal metal jacket to roof flashing with vapor-retarder mastic.

GG. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

HH. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

II. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Fire stopping and fire-resistive joint sealers are specified in Division 07 Section "Penetration Fire stopping."

JJ. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 INDOOR TANK AND VESSEL INSULATION APPLICATION

A. Blankets, Board, and Block Applications for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
   1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of tank and vessel surfaces.
   2. Groove and score insulation materials to fit as closely as possible to the equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joint. Stagger end joints.
   3. Protect exposed corners with secured corner angles.
   4. Install adhesive-attached or self-adhesive anchor pins and speed washers on sides of tanks and vessels as follows:
      a. Do not weld anchor pins to ASME-labeled pressure vessels.
      b. On tank and vessel, 3 inches' maximum from insulation end joints, and 16 inches on center in both directions.
      c. Do not over compress insulation during installation.
      d. Cut and miter insulation segments to fit curved sides and dome heads of tanks and vessels.
   5. Impale insulation over anchor pins and attach speed washers.
   6. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing
   7. Secure each layer of insulation with stainless-steel bands.
   8. Stagger joints between insulation layers at least 3 inches.
   9. Apply insulation in removable segments on equipment access doors and other elements that require frequent removal for service.
   10. Bevel and seal insulation ends around manholes, hand holes, ASME stamps, and nameplates.
   11. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Flexible Elastomeric Thermal Insulation Applications for Tanks and Vessels: Apply insulation over entire surface of tanks and vessels according to the manufacturer's written instructions.
   1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
   2. Seal longitudinal seams and end joints.

3.5 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vaporretarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
5. Where pipe expansion is anticipated, detail expansion compensation for insulation on Drawings and indicate intervals for its occurrence. See MICA's "National Commercial & Industrial Insulation Standards," Plate No. 41A.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed aluminum or heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

5. For larger sizes where fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.6 CALCIUM SILICATE INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with stainless-steel bands at 12-inch intervals and tighten without deforming insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless-steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same material and thickness as pipe insulation.
4. Finish flange insulation the same as pipe insulation.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded sections of insulation are not available, apply mitered sections of calcium silicate insulation. Secure insulation materials with stainless-steel wire.
3. Finish insulation of fittings the same as pipe insulation.

D. Apply insulation to valves and specialties as follows:

1. Apply mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation the same as pipe insulation.

3.7 REMOVABLE INSULATION JACKETING COVER APPLICATION

A. Apply removable insulating jacketing system on Domestic Hot-Water (DHW), Heating HotWater (HHW), and High Temperature Hot-Water (HTW) systems, and other heating water systems as follows:

1. Valves.
2. Strainers.
3. Pumps.
4. Regulators.
5. Flow meters.
6. Flow control, balancing, and instrumentation devices.
7. Steam Trap assemblies.
8. Service connection piping to heat exchangers.

B. Blanket Overlap: Blanket will overlap mating flanges as well as existing insulation with a minimum of 2" overlap. Where blanket cannot overlap existing oversized insulation, blanket will butt up to existing insulation with a friction closing seam. Open gaps are not acceptable. Blanket diameters which are 2" larger than existing insulation must be capped to eliminate open air void.

C. Any one piece will not exceed 50 lbs. in weight.

3.8 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.

1. Draw jacket material smooth and tight.
2. Apply lap or joint strips with the same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

C. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturers recommended adhesive.

D. Apply metal jacket where indicated, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant

recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches on center and at end joints.

E. Aluminum Jackets: Secure jackets according to jacket manufacturer's written instructions.

3.9 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 09 Section "Painting."

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

3.10 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Cold water piping.
4. Drainage piping located in crawl spaces, unless otherwise indicated.
5. Below-grade cold water piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.
8. Vertical storm drain piping except when needed for sound attenuation.
9. Overflow storm drain piping, except for the first 10 feet.

3.11 FIELD QUALITY CONTROL

A. Inspection: University’s Representative may perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect pumps and tanks randomly.

B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements and University’s Representative will then remove sections from each piece of equipment. Remove defective Work and replace with new materials according to these Specifications.

C. Reinstall insulation and covers on pumps and tanks uncovered for inspection according to these Specifications.

D. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect fittings and valves randomly selected by The University Representative.
2. Remove fitting covers from 10 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.
3. Remove fitting covers from 10 valves or 1 percent of valves, whichever is less, for various pipe sizes.

E. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

F. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.12 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.13 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic hot and recirculated hot water (potable or industrial).

1. Operating Temperature: 80 to 140 **and 180** degrees F.
2. Insulation Material: Preformed Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses for 140 deg F, and below:

a. Copper, Rounouts: 0.5” insulation (up to 12’ long and up to 2”)
b. Copper, Up to 4”: 1.0” insulation
c. Copper, 5” and larger: 1.5” insulation

4. Insulation Thickness: Apply the following insulation thicknesses for applications between 140 deg F and 180 deg F:

a. Copper, Rounouts: 0.5” insulation (up to 12’ long and up to 2”)
b. Copper, 3/4” and larger: 1.5” insulation

5. Field-Applied Jacket: Aluminum shall be provided on piping exposed in mechanical rooms and tunnels. ..
6. Vapor Retarder Required: Yes.
7. Finish: None.

B. Storm drain piping (only first ten feet from drain, sensitive areas, and as directed by Sound Consultant).

1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: Preformed mineral fiber.
3. Insulation Thickness: Apply the following insulation thickness: 0.5”
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.
6. Finish: None.

C. Service: Roof drain bodies including overflow drain.

1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: 0.5” 4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.
6. Finish: None.

D. Service: Sanitary waste piping serving ice machine, refrigerator or freezer condensate drains or air conditioning condensate drains floor sinks or drains. Insulate from drain body and a minimum of 25 linear feet of horizontal piping to prevent drain line from sweating. Coordinate freezer drain pipe insulation with installation of heat tape.

1. Operating Temperature: 35 to 100 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thickness: 0.75” 4. Field-Applied Jacket: None except use white PVC if exposed in kitchen area.
5. Vapor Retarder Required: Yes.
6. Finish: None.

E. Service: Condensate drains piping.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: 3/4”.
4. Field-Applied Jacket: Yes.
5. Vapor Retarder Required: Yes.
6. Finish: None.

F. Service: Exposed sanitary drains and domestic hot water supplies and stops for fixtures for the disabled shall be insulated with premanufactured products made for the specific installation.

G. G. Service: Process cooling water.

1. Operating Temperature: 50 to 65°F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: ¾“.

4. Field-Applied Jacket: None.
5. Vapor Retarder Required: No.
6. Finish: None.

H. Process Water: Install for piping above ceiling, as required by NFPA 13 and Campus Fire Marshal.

1. Operating Temperature: 50 to 65°F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: ¾“.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: No.
6. Finish: None.

3.14 EQUIPMENT INSULATION APPLICATION SCHEDULE

Equipment Service	Insulation Thickness	Insulation Type	Jacket Material	Vapor Barrier	Minimum Installed R-Value
<200°F Domestic and industrial water heat exchangers, pumps and equipment)	2”	Mineral fiber	Aluminum	No	5.6

END OF SECTION 22 0700

SECTION 22 1116 - DOMESTIC WATER PIPING AND VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes domestic water piping and valves, including industrial water, reclaim water, ambient temperature water and process cooling water piping and valves, for fixtures and/ or equipment inside the building and approximately to five feet outside of the building to the connection to Civil work.

B. Related Sections include the following:

1. Division 22 Section 22 0519 "Meters and Gages for Plumbing" for water meters, thermometers, pressure gages, and fittings.
2. Division 22 Section 22 1119 "Domestic Water Piping Specialties" for water distribution piping specialties.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings:

1. Domestic Water Service Piping: 160 psig.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

C. Water Test Reports: Specified in “Cleaning and Disinfecting” Article in Part 3.

D. Qualifications: Disinfecting company.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components. Comply with standards of University’s Representative (EH&S) for disinfection of potable water service piping.

C. Piping shall be manufactured in the United States of America, Australia, Canada or Japan only.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

C. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined

2.3 COPPER TUBING.

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.22, wrought-copper, solder-joint fittings.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Types K and L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.22, wrought- copper, solder-joint fittings.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
4. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
5. Copper, Press-Fit Fittings 4" and smaller: Copper and copper alloy, ASTM B16.18 and B16.22, IAPMO PS 117, EPDM sealing element, leak assurance design, Viega Pro-Press or equal.

2.4 VALVES

A. Ball Valves: Sizes NPS ½" – 2½" (typical)

1. Two-Piece, copper-alloy, MSS SP-110, Bronze body with full-port, 316 stainless steel ball and stem PTFE seats; and 600-psig minimum CWP rating and blowout-proof stem. Stem length shall clear insulation.

    a. Conbraco Industries, Inc.; Apollo Div. 77-140, (threaded only, provide male adapters).
    b. Nibco T-585-66-LF-EL threaded, S-585-66-LF-EL solder, T-585-66-LF-EL press ends, or equal.
    c. No known equal (Campus Standard).

B. AWWA, Cast-Iron Gate Valves 3" and Larger:

1. Manufacturers:

    a. American Cast Iron Pipe Co.; American Flow Control Div.
    b. Crane Co.; Crane Valve Group; Stockham Div.
    c. Grinnell Corporation; Mueller Co.; Water Products Div.
    d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
    e. McWane, Inc.; Kennedy Valve Div.
    f. McWane, Inc.; M&H Valve Company Division
    g. NIBCO INC.
    h. United States Pipe and Foundry Company.
    i. Or equal.

2. Non-rising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

    a. Minimum Working Pressure: 200 psig.
    b. End Connections: Mechanical joint, or flanged.
    c. Interior and Exterior Coating: Complying with AWWA C550, epoxy.
    d. Or equal.

C. Globe Valves: (NPS Sizes ½" – 3")

1. Type 2, Class 150, MSS-SP-80, bronze body and seat, PTFE disc, union-ring or bolted bonnet, with ferrous-alloy handwheel, threaded or solder ends. Rated for 300 psi WOG, 200 °F maximum, and suited for potable water.

    a. Crane Co.; Crane Valve Group; Crane Valves. 7TF
    b. Crane Co.; Crane Valve Group; Stockham Div. B22/B24
    c. NIBCO INC. T-235-Y
    d. Or equal.

D. Check Valves: (NPS Sizes ½" – 3")

1. Swing Check, Type 3, Class 150, MSS-SP-80, bronze body and seat, Y-pattern, screwed cap, threaded or solder ends. Rated for 300 psi WOG, 200 °F maximum, and suited for potable water.

    a. Crane Co.; Crane Valve Group; Crane Valves. 137
    b. Crane Co.; Crane Valve Group; Stockham Div.
    c. NIBCO INC. T433-Y
    d. Or equal.

E. Drain valves

1. Drain valves shall use ball valve specified above with ¾" hose threads outlet and metal screw on cap.

2.5 PE ENCASEMENT

A. PE Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105 PE film, 0.008inch minimum thickness, tube or sheet.

PART 3 - EXECUTION

3.1 EXCAVATION

A.Refer to Division 31 Section 31 2000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Underground Domestic Water Service Piping: Use type K soft or hard drawn copper with copper pressure fittings and brazed or silver solder joints. For trap primers only, use soft copper tube, Type K.

B. Aboveground Domestic Cold and Hot Water Piping: Use Type L hard drawn copper with wrought copper fittings and 95-5 solder or ASTM B 813 water flushable, lead-free flux and ASTM B 32 lead-free alloy solder (Bridgit or equal).

1. Press-fit fittings may be used on 4" and smaller pipe sizes.

C. Aboveground Domestic, industrial hot water and process cooling water Recirculating Water Piping: Use Type L hard drawn copper with wrought copper fittings and 95-5 solder or ASTM B 813 water flushable, lead-free flux and ASTM B 32 lead-free alloy solder (Bridgit or equal).

1. Press-fit fittings may be used on 4" and smaller pipe sizes.

D. Aboveground Non-Potable-Water Piping (Soft Water, Industrial Water, Reclaim Water, Ambient Temperature Water, Process Cooling Water): Type L hard drawn copper with wrought copper fittings and 95-5 solder or ASTM B 813 water flushable, lead-free flux and ASTM B 32 lead-free alloy solder (Bridgit or equal).

1. Press-fit fittings may be used on 4" and smaller pipe sizes.

E. Automatic faucets and flush valves shall be piped with copper tube or pipe. Exception: Automatic faucets located in public restrooms serving wall hung lavatories shall have exposed braided stainless steel flexible type connectors with threaded ends. (No plastic tubing is allowed).

F. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

G. Flanges may be used on aboveground piping only.

H. Rolled-Grooved joints may be used on aboveground cold water piping only for sizes up to 6".

I. Groove-less clamp, cut groove pipe and fittings, reducing couplings, bushings, mechanical tees, street elbows or saddle fittings are not acceptable for use on campus.

3.3 VALVE APPLICATIONS

A. Drawings shall indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2" and smaller. Use gate valves with flanged ends for piping NPS 2-1/2" and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use cast-iron globe valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water-Piping, Balancing Duty: balancing valves shall be automatic flow limiters with fixed calibrated flow rate.
4. Drain Duty: Ball valves with hose-end and cap.
5.

3.4 PIPING INSTALLATION

A. Refer to Division 33 Section 33 1110"Site Water Distribution Piping" for site water distribution and service piping.

B. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for basic piping installation.

C. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.

D. Install underground copper tubing according to CDA's "Copper Tube Handbook."

1. Encase piping with polyethylene film according to ASTM A674.

E. Install galvanized steel or HDPE sleeve with water stop and mechanical sleeve seal at each service pipe penetration through basement wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for sleeves and mechanical sleeve seals.

F. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for wall penetration systems.

G. Install shutoff valve, hose-end drain valve, strainer, water meter, pressure gage, and test tee with valve, inside building at each domestic water service. Refer to Division 22 Section 22 0519 "Meters and Gages for Plumbing" for pressure gages and meters, and to Division 22 Section 22 1119 "Domestic Water Piping Specialties" for strainers.

H. Install water-pressure regulators downstream from main building shutoff valve. Refer to Division 22 Section 22 1119 "Domestic Water Piping Specialties" for water-pressure regulators.

I. Install aboveground domestic water piping level and plumb.

J. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

K. Perform the following steps before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.

L. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

M. Check plumbing specialties and verify proper settings, adjustments, and operation.

1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.

N. Energize pumps and verify proper operation.

O. Domestic water piping beneath concrete slabs shall be avoided. Trap primer piping shall be with no joints below slab.

P. Piping penetrations of floors, walls and roofs shall be carefully detailed and installed. Insulation shall be continuous through penetrations. Coordinate on drawings.

Q. Exterior hose bibs shall be provided at new buildings and plazas to wash down walks, loading docks and drives. Provide at maximum of 100 feet apart along the perimeter of the building. Recessed wall box type with loose key stop and vacuum breaker shall be used on buildings. Locations shall be as approved by the University. Coordinate on plans.

R. Provide service hose bibbs on roof for HVAC Air Handling Units and Major Exhaust Fans.

S. Reclaimed water piping shall be wrapped or painted purple and labelled in accordance with requirements described for chapter 16A Non-Potable Water Reuse Systems of the 2013 California Plumbing Code.

3.5 CROSS CONNECTION

A. Atmospheric vacuum breakers shall be provided on sink outlets in lab areas, or a branch line backflow preventor may be installed in a water line supplying an area of a mechanical room, lab or labs. When a branch line backflow preventor is used, the water piping downstream of the device must be labeled as “non-potable or industrial water” (similar for reclaim water or process cooling water). Lab faucets by others under another division.

B. Cross connection is any connection or arrangement of piping between two otherwise separate piping systems, one of which contains potable water and the other non-potable water or industrial fluids of questionable safety. Cross connection may cause non-potable fluid to enter the potable water system by backflow, back pressure, or back siphonage, and this shall not be allowed.

C. The University obtains water from multiple connections to the Riverside Water District RWD system. These connection points have an RWD meter and cross connection device. Projects will connect downstream of these points to University owned water mains.

D. The University has a responsibility to protect the potable water system on campus. Of the two methods of protection (containment or internal plumbing control), the University uses the internal plumbing control method.

E. The internal plumbing control method involves the installation of the appropriate device at the point of each potential cross connection. This requires the use of air gaps, vacuum breakers, etc., at each plumbing fixture, equipment, tank, sink, etc., to protect the potable water system from backflow. Since many of the buildings on campus are used for both research and academic purposes, the internal control method is the only positive economical method to protect the potable water system.

F. Identify each cross connection and provide adequate protection as described in the CPC. The CPC recognizes six methods for backflow prevention: Air Gap (AG), Atmospheric Vacuum Breaker (AVB), Pressure Vacuum Breaker (PVB), Pressure Vacuum Breaker Spill-Proof Assembly (SVB), Reduced Pressure Backflow Prevention Device (RP), and the Double check Valve Assembly (DC). The design engineer shall consult the Plumbing Code, Manual of Cross Connection Control, 9th edition and future edition published by University of Southern California "Foundation for Cross-Connections, California Administrative Code, Title 17-Public Health, for the proper device to use. The University prefers the use of Reduced Pressure Backflow Preventors. Backflow prevention devices will not be allowed in pits.

3.6 JOINT CONSTRUCTION

A. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for basic piping joint construction.

B. Soldered Joints: Use Tin-Antimony 95-5 solder or ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure.

C. Rolled-Grooved Joints: Assemble joints with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

D. Press-fit Joints: Prepare tubing and fitting for assembly per manufacturer's instructions. Fully insert tubing into the fitting and mark tubing at shoulder of fitting. Extract tubing and verify fitting alignment then re-insert. Press fitting per manufacturer's instructions with tools approved by the fitting manufacturer.

3.7 VALVE INSTALLATION

A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment.

B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops.

C. Install drain valves for equipment, at base of each water riser.

D. Install flow-limiting valves in each hot-water circulation return branch. Refer to Division 22 Section 22 1119 “Domestic Water Piping Specialties" for flow limiting devices.

3.8 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing" for seismic restraint devices.

B. Refer to Division 22 Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or Type 42 clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. MSS Type 1, adjustable, steel clevis hangers.
3.

C. Install supports according to Division 22 Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters in accordance with CPC Tables 313.1 and 313.6.

F. Install supports for vertical copper tubing in accordance with CPC requirements.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:

1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes required for the flow, but not smaller than sizes of water heater connections. Valves shall be line size. Any reduction in pipe size for connection to heater shall occur after valves.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes required for the flow, but not smaller than required by plumbing code. Refer to Division 22 Section 22 4000 "Plumbing Fixtures."

3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by University's Representative.
2. During installation, notify University's Representative at least 72 hours before inspection must be made. Perform tests specified below in presence of University's Representative:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange for final inspection by University's Representative to observe tests specified below and to ensure compliance with requirements.

3. Re-inspection: If University's Representative finds that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
4. Reports: Prepare inspection reports and have them signed by University's Representative.

B. Test domestic water piping as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Cap and subject piping to static water pressure of 150 psig or 1.5 times the working pressure, whichever is greater, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours with no decrease in pressure. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until there are no leaks.
5. Prepare reports for tests and required corrective action.

3.11 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Use purging and disinfecting procedure prescribed, use procedure described in AWWA C651 or as described below:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
b. An optional disinfecting procedure that can be used in lieu of paragraph above is to drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.

c. Submit water samples in sterile bottles to the University's Representative for review and acceptance by the University's Environmental Health and Safety Representatives. Repeat procedure if biological examination shows evidence of contamination.
d. Underground mains shall be flushed at maximum flow during non-peak campus usage time.

B. Prepare reports of purging and disinfecting activities.

C. After completing drinking fountain installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

D. Clean drinking fountains, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following domestic, industrial water, reclaim water, ambient temperature water and process cooling water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Flow limiting devices.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Water hammer arresters.
12. Air vents.
13. Trap-seal primer valves.
14. Water Filters.
15. Supply Stops.

B. Related Sections include the following:

1. Division 22 Section 22 0519 "Meters and Gages for Plumbing" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section 22 1116 "Domestic Water Piping and Valves" for water meters.
3. Division 22 Section 22 4500 "Emergency Plumbing Fixtures" for water tempering equipment.
4. Division 22 Section 22 4700"Drinking Fountains" for water filters for drinking fountains.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 160 psig, unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University's Representative, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.

B. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.

C. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers

1. Manufacturers:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Wilkins Div.
   f. Or equal.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze or brass.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. MIFAB, Inc.
   d. Watts Industries, Inc.; Water Products Div.
   e. Woodford Manufacturing Company.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
   g. Zurn Plumbing Products Group; Wilkins Div.
   h. Or equal.

2. Standard: ASSE 1011.
3. Body: Bronze, non-removable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers

1. Manufacturers:
   a. Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.
   e. Or equal.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4.
5. Pressure Loss at Design Flow Rate: Maximum 5 psig.
6. Accessories:

   a. Valves: Ball type, on inlet.

D. Laboratory-Faucet Vacuum Breakers: Provided by other section of work.

2.3 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers

1. Manufacturers:

   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Watts Industries, Inc.; Water Products Div.

e. Zurn Plumbing Products Group; Wilkins Div.
f. Or equal.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size**:** NPS **1/2** and 3/4**.**
5. Body: Bronze.
6. End Connections: Union**,** joint.
7. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers

1. Manufacturers:

a. Conbraco Industries, Inc. # 40-200, 3/4 " – 2" in size, bronze.
b. FEBCO; SPX Valves & Controls. # 825Y or # 825YA, 3/4" – 2" in size, bronze.
c. Watts Industries, Inc.; Water Products Div. #909. 4" & larger to be epoxy coated on interior and exterior.
d. Zurn Plumbing Products Group; Wilkins Div. # 450DA, # 350DA, # 375A, # 475 VBGVIG and # 450DA.
e. Wilkins Model 375A-FSC, 2 1/2" – 6", cast iron with FDA approved epoxy coating on interior and exterior.
f. Or equal.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Pressure Loss at Design Flow Rate: Maximum 12psig.
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through.
9. Accessories:

a. Valves: Ball type with threaded, solder or press fit ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2 1/2 and larger.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies

1. Manufacturers:

a. Conbraco Industries, Inc. # 40-100, 3/4" – 2", bronze body.
b. FEBCO; SPX Valves & Controls. # 805 Y Series, 3/4" – 2", bronze body.
c. Watts Industries, Inc.; Water Products Div. #709. 3/4" – 3", bronze body, and 4"10" cast iron with fused epoxy coating on interior and exterior.
d. Zurn Plumbing Products Group; Wilkins Div.

e. Or equal.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through.
8. Accessories:

a. Valves: Ball type with threaded, solder or press fit ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 21/2 and larger.

D. Hose-Connection Backflow Preventers

1. Manufacturers:

a. Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.
c. Woodford Manufacturing Company.
d. Or equal.

2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.4 WATER PRESSURE-REDUCING VALVES

A. Water Regulators – Direct Acting Type

1. Manufacturers:

a. Cash Acme.
b. Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.
e. Or equal.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.

6. End Connections: Threaded, solder or press fit for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water regulators – Pilot Type

1. Manufacturers:

   a. CLA-VAL Automatic Control Valves.
   b. Watts Industries, Inc.
   c. Watts Industries, Inc.; Watts ACV.
   d. Zurn Plumbing Products Group; Wilkins Div.
   e. Or equal.

2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

   a. Size: As shown on drawings.
   b. Pattern: Horizontal or Angle Globe valve design.
   c. Trim: Stainless steel.

5. End Connections: Threaded, solder or press fit for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.5 FLOW LIMITING DEVICES

A. Water Balancing Valve: Manual Calibrated Balancing Valves, NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain manually set position. Manual Calibrated Balancing Valves, NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain manually set position.

1. Manufacturers:

   a. B&G Circuit Setter
   b. Taco Circuit Setter
   c. Or equal.

2. Pressure Rating: 230 psi.
3. Temperature Rating: 250°F.
4. Body Material: Brass Lead-free.
5. Body Tapping: 1/4” NPT with brass P/T test valves.

6. PSID Range: 1.0-14.
7. Flow: As indicated on drawings.
8. Provide shut off valves on both sides of flow limiting device.

2.6 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves

1. Manufacturers:

   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Lawler Manufacturing Company, Inc.
   d. Leonard Valve Company.
   e. Powers; a Watts Industries Co.
   f. Or equal.

2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Chrome-plated bronze.
8. Tempered-Water Setting: 105-110 deg F.

B. Primary Water Tempering Valves

1. Manufacturers:

   a. Heat-Timer Corporation.
   b. Holby Valve Co., Inc.
   c. Or equal.

2. Standard: ASSE 1017, thermostatically controlled tempering valve, listed as tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze.
5. Temperature Control: Manual or automatic.
6. Inlets and Outlet: Threaded or flanged.
7. Selected Primary Water Tempering Valve Size: Per drawings
8. Tempered-Water Setting: 120 and 140deg F.
9. Tempered-Water Design Flow Rate: Per drawings.
10. Pressure Drop at Design Flow Rate: Maximum 5psig.
11. Tempered-Water Outlet Size: Per Drawings.
12. Cold-Water Inlet Size: Per drawings.
13. Hot-Water Inlet Size: Per drawings.
14. Valve Finish: Rough bronze

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

1. Pressure Rating: 160 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
6. Drain: Factory-installed, hose-end drain valve.

2.8 OUTLET BOXES (See Fixture Schedule)

2.9 HOSE STATIONS (See Fixture Schedule)

A. Manufacturers:

1. Armstrong International, Inc.
2. Leonard Valve Company.
3. Strahman Valves, Inc.
4. T & S Brass and Bronze Works, Inc.
5. Or equal.

B. Hot- and Cold-Water Hose Stations, WS-1

1. Standard: ASME A112.18.1.
2. Type Faucet: Thermostatic mixing valve.
3. Hose-Rack Material: Stainless steel.
4. Body Material: Bronze with stainless-steel wetted parts.
5. Body Finish: Rough bronze.
6. Mounting: Wall, with reinforcement.
7. Supply Fittings: Two NPS 3/4 gate, globe, or ball valves and check valves and NPS 3/4 copper, water tubing. Omit check valves if check stops are included with fitting.
8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 25 feet 0 long.
9. Nozzle: With hand squeeze on-off control.
10. Vacuum Breaker: Integral or factory-installed, non-removable, manual-drain-type, hose connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.2.10 HOSE BIBBS (See Fixture Schedule)

2.11 WALL HYDRANTS (See Fixture Schedule)

2.13 WATER HAMMER ARRESTERS

A. Water Hammer Arresters

1. Manufacturers:

a. AMTROL, Inc.
b. Josam Company.
c. MIFAB, Inc. # MWH.
d. PPP Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
g. Tyler Pipe; Wade Div.
h. Watts Drainage Products Inc.
i. Zurn Plumbing Products Group; Specification Drainage Operation.
j. Or equal.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.14 AIR VENTS

A. Bolted-Construction Automatic Air Vents

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

C. Manual Air Vent Bronze body ball valve with stainless steel ball; NPS ½.

2.15 TRAP-SEAL PRIMER VALVES

A. Flush Valve tailpiece type trap primer.

1. This is a primary trap priming system as Campus Standard. Trap priming accessory as part of the flush valve provided, Sloan # VBF-72-A.

2. Trap primer for use with exposed flush valve with one-piece chrome plated flush connection water deflector and flex-bend tube connection to wall with escutcheon.

B. Supply-Type, Trap-Seal Primer Valves

1. This type shall be used only when flush valve is not available in vicinity.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.

   a. MIFAB, Inc. # MR-500.
   b. Or equal.

3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Provide shut off valve up stream
9. Install in concealed locations. Provide access panel to provide access to trap primer and valve.
10. Removable and serviceable cartridge.

C. Drainage-Type, Trap-Seal Primer Valves: Shall not be used.

2.16 WATER FILTER

A. Manufacturers:

1. CUNO, Inc.
2. Or equal (no known equal that matches filters stocked by the University)

B. General: Cartridge-type assemblies suitable for potable water. Include housing, fittings, filter cartridges, and cartridge and caps.

C. Wall-Mounting Type: Housing head section with threaded inlet and outlet, mounting bracket, and removable lower section for 10-inch long filter cartridge.

1. Housing Material: Stainless steel, 150-psig minimum operating pressure.
2. Cartridge: Activated charcoal filter media, 10 inches, 10-micron-particulate removable rating.

2.17 SUPPLY STOPS

A. Manufacturers:

1. American Standard.
2. Kohler.
3. Delta

4. Brass Craft, Heavy Duty.
5. Or equal.

B. Description: Heavy pattern, 1/2" OD x 12" long chrome plated brass or stainless steel flexible risers with stuffing box cartridge, 1/4 turn ball valve, Stainless steel wall flange, loose key tee handle with Key, lock shield. Outlet end to suit fixture.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with University's Representative's instructions.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with throttling valve. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves and bypass with throttling valve. Install pressure gages on inlet and outlet.

E. Install Flow Limiting Devices on each hot water return branch in locations where they can easily be serviced. Provide shut off valves on each side and check valve.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.

G. Install strainers for water on supply side of each control valve, water pressure reducing valve, [solenoid valve**,** water Meter and pump.

H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking scope by others. Refer to Division 06 Section 06 1053 "Rough Carpentry."

I. Install hose station boxes with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install shutoff valve on outlet if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire retardant-treated-wood blocking scope by others. Refer to Division 06 06 1053 Section "Rough Carpentry."

J. Install water hammer arresters in water piping according to PDI-WH 201. Provide isolation valve and access panel for each WHA with threaded joints.

K.

L. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

M. Install water filters with shut off valves and unions or flanges upstream and downstream of filters. Install pressure gage down stream of filters.

N. Reclaimed water piping shall be wrapped or painted purple and labelled in accordance with requirements described for chapter 16A Non-Potable Water Reuse Systems of the 2013 California Plumbing Code.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section 26 0256 "Grounding and Bonding for Electrical Systems." Covered by electrical work.

C. Connect wiring according to Division 26 Section 26 05219 "Low Voltage Electrical Power Conductors and Cables." Covered by electrical work.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
8. Double-check, detector-assembly backflow preventers.
9. Water pressure-reducing valves.
10. Flow limiting devices.

11. Primary, thermostatic, water mixing valves.
12. Manifold, thermostatic, water-mixing-valve assemblies.
13. Primary water tempering valves.
14. Outlet boxes.
15. Hose stations.
16. Supply-type, trap-seal primer valves.
17. Water filters

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section 22 0553 "Identification for Plumbing."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each specialty including pressure vacuum breaker, reduced-pressure-principle backflow preventer, and double-check backflow-prevention assembly according to University's Representative and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

SECTION 22 1123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation, and process cooling water circulation:

1. Close-coupled, in-line, centrifugal pumps.
2. End Suction Pumps.

1.2 SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Pumps, diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section 01 6000 "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University’s Representative, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Manufacturers:

1. Bell & Gossett
2. Grundfos Pumps Corp. Model UP or UPS.
3. Or equal.

B. Description: Maintenance-free, in-line, wet rotor type with the motor mounted directly to the pump volute for use in an open system. The motor shall be cooled and lubricate by the pumped fluid and shall require no schedule maintenance.

1. Pump and Motor Assembly: The pump volute shall be 304 stainless steel and rated at 145 psi working pressure.
2. Casing: Stainless steel, with flange connections.
3. Impeller, impeller inlet cone, rotor can and rotor cladding: Stainless steel.
4. Motor: Single speed.
5. The pump shall not have a coupling or mechanical seal.
6. Flange to flange: 6 ½”. University Standard.

2.3 HORZONTIAL MOUNTED, IN-LINE, FLEXIBLE COUPLED CENTRIFUGAL PUMP

A. Manufacturers:

1. Bell & Gossett Domestic Pumps
2. Grundfos Pumps Corp.
3. Armstrong Pumps, Inc.
4. Taco, Inc.
5. Or equal.

B. Description: Base-mounted, centrifugal, flexible-coupled, end-suction, single-stage, bronze fitted, back-pull-out, radially split case design; rated for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on

volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.

2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
3. Wear Rings: Replaceable, bronze casing ring.
4. Shaft and Sleeve: Steel shaft with bronze sleeve.
5. Seals: Mechanical, with Hi resist seat, carbon washer, viton elastomer, stainless steel spring and parts.
6. Pump shaft bearings: Grease-lubricated ball bearings in cast-iron housing.
7. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
8. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
9. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.
10. Motor: Secured to mounting frame, with adjustable alignment.

2.4 CONTROLS

A. In-line circulator pump shall operate continuously unless shutdown by Building Automation System.

B. Aquastats: Electric; adjustable for control of hot-water circulation pump.

1. Manufacturers:
   a. Honeywell International, Inc.
   b. Square D.
   c. White-Rodgers Div.; Emerson Electric Co.
2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
3. Operation of Pump: On or off.

C. Aquastats: Electric; adjustable for control of hot-water circulation pump.

4. Manufacturers:
   a. Honeywell International, Inc.
   b. Square D.
   c. White-Rodgers Div.; Emerson Electric Co.
5. Type: Water-immersion sensor, for installation in hot-water circulation piping.
6. Operation of Pump: On or off.

D. In-line centrifugal pump shall be controlled by variable frequency drive. Refer to Division 23 Section 23 0510 “Variable Frequency Drives” and Division 22 Section 22 0513 “Motors For Plumbing”.

2.5 BUILDING-AUTOMATION-SYSTEM INTERFACE

A. Provide controls for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

C. Install in-line, horizontal and sealless centrifugal pumps with motor and pump shafts horizontal.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section 22 1116 "Domestic Water Piping and Valves."

1. Install shutoff valve on suction side of pumps, and check valve and shutoff valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 22 Section 22 1116 "Domestic Water Piping and Valves" for ball valves.
2. Install pressure gages taps at suction and discharge of pumps. Refer to Division 22 Section 22 0519 "Meters and Gages for Plumbing" for pressure gages and gage connectors.

D. Grounding of equipment under another section of work. Refer to Division 26 Section26 0526 "Grounding and Bonding for Electrical Systems.".

E. Connection of wiring under another section of work. Refer to Division 26 Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables.".

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    b. Verify that pump is rotating in the correct direction.

4. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
5. Start motor.
6. Open discharge valve slowly.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section 01 7900 "Demonstration and Training."

END OF SECTION 22 1123

SECTION 22 1314 - WATER SOFTENING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section lists equipment to be used to condition water. The water conditioning method shall be a "Resin Exchange Water Softener System" whereas the media is to be replaced by a qualified regeneration service provider under contract at regular intervals. The end of a softener service cycle is determined either by a timed service run, total gallon throughput, or a high measure of hardness in the softener effluent.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Special Conditions, Mechanical Supplemental Requirements Divisions 23, and Division-1 Specification sections, apply to work specified in this section.

1.3 RELATED WORK

A. Refer to Section 22 1116 "Domestic Water Piping and Valves".

1.4 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Division 1.

1.5 SUBMITTALS

A. Submit shop drawings on all items specified herein.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.

2.2 MATERIALS

A. All materials specified herein shall be new unless noted otherwise.

2.3 EQUIPMENT

A. Softener

1. Scope:

a. Furnish all equipment and material necessary for complete installation of a water softening system. Provide all work in accordance with these specifications and all applicable local and state plumbing codes, AWWA, ASME, and ASTM standards.

b. The water softener system shall be furnished complete with softener tanks and internals, single point connection of service inlet and outlet, and drain. The water softener shall be rated for a maximum service flow rate of SC gallons per minute with a pressure loss not to exceed 25 psig. The water softener system shall be as manufactured by Culligan, or approved equal and as specified herein.

2. Project Data (each Unit):

PROJECT DATA	SPECIFIED VALUE
Continuous Flow Rate:	170-180 GPM @ 15 PSI loss/Softener
Peak Flow Rate:	250 GPM @ 25 PSI loss/Softener
Minimum Recommended Flow:	25 GPM
Resin Quantity:	Cullex Cation Resin, Na*
Maximum Capacity:	960 kgr@ 450 lbs. Salt*
Minimum Capacity:	600 kgr@ 180 lbs. Salt*
Tank Size, in.:	36" Dia. 60" Side shell
Tank Area, ft^2:	7.07
Freeboard:	8”- Resin Exchange
Tank Rating:	150 PSI @ 130˚F, ASME Code
Softener Tank Quantity:	2
Total Water Hardness:	10-25 GPG
Water Demand:	24 Hours/Day

3. Regeneration Data:

Resin Exchange Service. Capacity Specified above is based on indicated salt dosage. Regeneration Services By: Local Culligan Dealer or equivalent.

4. System Requirements:

Operating Temperature Range	35 - 120 degrees F.
Operating Pressure Range	30-150 PSIG
Pipe Connections, Inches:	
Inlet Size	3” 150# RFSO Flange
Outlet Size	3” 150# RFSO Flange
Fill and Drain Conn.	2” 150# Pad Flange

5. Softener Tanks:

   a. Each softener tank shall be of electric weld construction built in accordance with the ASME Code and so stamped and certified. Exchange tanks 30" diameter and under shall have the following: One (1) 3”x12” site glass port; One (1) 12”x16” Manway with cover (second manway is optional); tank support legs shall be four (4) Angle Legs w/ base plates & support gussets.

6. Internal Distribution System:

   a. The underdrain system shall be PVC 3” Hub & Lateral underdrain distributor & 3” Upper diffuser manifold.

7. Tank Finish:

   The tank interior lining shall be applied over a sandblasted surface and shall be SSPPC-SP10 Devoe 233H 10-16 mil DFT, or equal. The tank exterior shall be cleaned free of any grease, oil, or millscale and exterior lining with Tnemec 161SC06 Safety Blue, 7-8 DFT, or equal.

8. Ion Exchange Resin:

   a. The Ion exchange resin shall be Cullex – 00156001, 00156314 premium grade high capacity synthetic sulfonated styrene divinylbenzene type to be furnished in bead form, ionic form: sodium, or equal.

9. Piping:

   a. The manufacturer is to furnish the softener tanks.

   b. The contractor shall furnish inlet and outlet service lines to the tanks, 1 1/2” Service lines for Resin Inlet and outlet, 1 1/2” pressurized water line at fill site with Male Cam lock, 1 1/2” pressurized water line at fill

site, 1 1/2" Drain line (with shut off valve) off 2", 3" or 4" soft water service line with Wye strainer in line and shut off valve to process exchange fitting and install interconnecting piping, drain shall have an air gap conforming to local codes to permit observation of the discharge backwash water and manufacturer shall provide a valve drain at the lowest point of the softener system. The piping shall be Schedule 40 galvanized with Class 150 standard malleable iron fittings 3" and under, 4" piping and larger shall be black carbon steel.

10. Instructions and Start-Up:

    a. A complete set of operating instructions covering the installation, maintenance, and operation of the softener system shall be furnished, bound in booklet form. The contractor shall provide the service of a competent supervising agent from the water softener manufacturer to inspect the completed installation, start the water softening system in operation, and acquaint the operator with the proper operation and maintenance of this equipment.

11. Equipment Description for Approval:

    a. Upon request, manufacturer selected shall furnish a complete and detailed equipment list for approval including a drawing showing pertinent dimensions of this system.

12. Guarantees:

    a. Attrition loss of the ion exchange resin is guaranteed not exceed 3% per year for a period of three years. All mechanical equipment is guaranteed for one year against defects in workmanship or material. Any part proving defective will be replaced or repaired within this period. The manufacturer guarantees that under actual operating conditions, the resin shall not be washed out of the system during the service run or backwashing period; that the turbidity and color of the effluent by reason of passing through the softener system shall not be greater than the incoming water and that the underdrain system, gravel, and resin shall not become fouled either with turbidity or by dirt, rust, or scale from the softening system, or present in the hard water while operating as noted on manufacturer's instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Water softener shall be installed level in location as shown and detailed on the drawings. All water piping to and from the softener shall be supported from the building structure; piping shall not be supported from the softener.

B. The manufacturer shall provide start up service for the unit.

3.2 TEST

A. After satisfactory performance of the sequence of operation, water samples of raw and conditioned water shall be taken and sent to a lab to verify performance of conditioning the water.

B. After each exchange, the Driver cleans up, checks for leaks and places dated tag on tank that it has been exchanged.

END OF SECTION 22 1314

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building and to 5 feet outside of building.

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections include the following:

1. 22 Section 22 6000 "Chemical-Waste Piping" for chemical-waste and vent piping systems.
2. Division 22 Section 22 1329 "Sanitary Sewage and Lab Waste Pumps."

1.2 DEFINITIONS

B. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water
2. Sanitary Sewer, Force-Main Piping: 70 psig

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to CBC Requirements for Seismic Zone 4.

1.4 SUBMITTALS

A. Submit sanitary waste and vent systems as a complete package, including hangers and supports. Clean-outs, floor drains and floor sinks and plumbing specialties.

B. Product Data: For pipe, tube, fittings, and couplings.

C. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified California registered professional engineer for selecting seismic restraints.

D. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Piping and fittings shall be manufactured in the United States of America, Australia, Canada or Japan only.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, ASTM A 888 or CISPI 301. The piping shall bear collective trademark of the CISPI.

B. Shielded Couplings: ASTM C 1277 & ASTM C1540, minimum 24 gauge, type 304 Stainless steel assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop. Heavy Duty.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, minimum of four stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Manufacturers:

1) Husky Series SD-4000.
2) ANACO.
3) Clamp All 125.

4) Ideal Div.; Stant Corp.
5) Or equal.

2.6 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.22, wrought-copper, solder-joint fittings.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.7 SPECIAL PIPE FITTINGS

A. Flexible, Non-pressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.
g. Or equal.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Pressure Pipe Couplings Where Applicable: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.; DMD Div.
c. EBAA Iron Sales, Inc.

d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
e. JCM Industries, Inc.
f. Smith-Blair, Inc.
g. Viking Johnson.
h. Or equal.

2. Center-Sleeve Material: Stainless steel.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

2.8 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, LLDPE film of 0.008-inch minimum thickness.

B. Form: Tube

C. Color: Black

PART 3 - EXECUTION

3.1 EXCAVATION

A.Refer to Division 31 Section 31 2000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping 1-1/2” shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings.
2. Copper DWV tube, copper drainage fittings, and soldered joints.

C. Aboveground, soil and waste and vent piping NPS 2 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints (except for vent).
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.

D. Underground, soil, waste, and vent piping shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

E. Sanitary-sewage force mains shall be any of the following:

1. Hard copper tube, Type K for below grade, Type L for above ground; wrought copper pressure fittings; brazed joints below grade, solder joint or mechanical joint above ground.

F. Indirect and condensate Drains: Type L hard drawn copper piping with wrought copper fittings.

G. NPS 2 1/2 piping shall not be used, provide NPS 3.

H. CPC does not permit discharge of more than 140-degree F waste water into sewer. Provide cooling-blending water systems for drain discharges from Lab Equipment that discharge exceeds 140-degree F.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 33 Section 33 3100 "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing."

D. Install cleanouts at grade and extend to 5’-0” outside of the building where building sanitary drains connect to building sanitary sewers and provide a two-way cleanout. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

E. Install galvanized steel or HDPE sleeve with water stop and mechanical sleeve seal at each service pipe penetration through a basement wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and

reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise approved by the University's Representative:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping sizes up to 3", 1 percent downward in direction of flow for piping sizes 4" and above.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping sizes up to 3", 1 percent downward in direction of flow for piping sizes 4" and above.
3. Vent Piping: Sloping is not required. Lay horizontal vent piping level with no sections rapped, otherwise provide 1 percent down toward vertical fixture vent or toward vent stack.

M. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of CPC.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by University's Representative.

O. Do not use copper piping on urinals.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. Mechanical Joint for copper tube pump discharge piping: Compression joint grooved end, copper coating using elastomeric gasket. ASTM A 536 housing, for rigid installation, ASTM A536 flanges adapter.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free alloy solder; and ASTM B 828 procedure.

E. The use of adhesives, lubricants, sealants, etc. or the addition of any substance between no-hub cast iron pipe and coupling shall be prohibited.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section 22 1116 "Domestic Water Piping and Valves."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Install full-port ball valve for piping NPS 2" and smaller.
2. Install gate valve for piping NPS 2-1/2" and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to sewage backflow or if required by code.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type.
2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Backwater valve are specified in Division 22 Section 22 1319 "Sanitary Waste Piping Specialties."

A. Seismic-restraint devices are specified in Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing."

B. Pipe hangers and supports are specified in Division 22 Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment." Install supports according to Division 22 Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor not to exceed 10 vertical spacing.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. Comply with CPC Section 313, Table 313.1 and 313.6.
2. Support adjacent to a joint, not exceeding 18 inches from joint.
3. Hangers shall not be placed on couplings.
4. Provide 3/8" rod size up to NPS 2, 1/2" rod for NPS 3, 5/8" rod for NPS 4 and NPS5, 3/4" rod for NPS 6 and 7/8" rod for NPS 8 through NPS 12.

F. Install supports for vertical cast-iron soil piping maximum at every floor to floor.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters in accordance with CPC Tables 313.1 and 313.6.

H. Install supports for vertical copper tubing in accordance with CPC requirements.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by CPC.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by CPC.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by CPC.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main or sanitary manhole.
2. Sewage Pumps: To sewage pump discharge.

3.8 FIELD QUALITY CONTROL

A. During installation, notify University’s Representative at least 24 hours before inspection must be made. Perform tests specified below in presence of University’s Representative.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by University’s Representative to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If University’s Representative finds that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by University’s Representative.

D. Test sanitary drainage and vent piping according to procedures of California Plumbing Code or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of University's Representative or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

F. The University shall run a camera through storm piping upon substantial completion of the project. Any broken or damaged new or affected pipe found shall be repaired as part of the basic contract.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1316

SECTION 22 1319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains and Floor Sinks.
4. Trench drains.
5. Roof flashing assemblies.
6. Through-penetration firestop assemblies.
7. Miscellaneous drainage piping specialties.
8. Flashing materials.

B. Related Sections include the following:

1.Division 22 Section 22 4000 "Plumbing Fixtures" for hair interceptors.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PUR: Polyurethane plastic.

G. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Backwater valve
2. Cleanouts
3. Floor drains and floor sinks
4. Trench drains
5. Roof flashing assemblies By Roofer.

6. Through penetration fires top assemblies by other vendor.
7. Miscellaneous drainage piping specialties
8. Flashing materials
9. Wiring Diagrams: Power, signal, and control wiring.

B. Manufacturer Seismic Qualification Certification: Submit certification that accessories, and components will withstand seismic forces defined in Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing." Include the following:

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in California Electrical Code (NFPA 70), Article 100, by a testing agency acceptable to University's Representative, and marked for intended use.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.

B. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.

C. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or equal.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with boltedor threaded access check valve.
6. End Connections: Hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled to hang closed or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, or A888, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor or grade; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
    c. Watts Drainage Products Inc.
    d. Zurn Plumbing Products Group; Specification Drainage Operation.
    e. Or equal.

2. Size: Same as floor drain or floor sink outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain or floor sink.
4. Check Valve: Removable ball float.
5. Inlet: Threaded as applicable.
6. Outlet: Threaded or no-hub.

2.3 CLEANOUTS

A. Exposed Exterior Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Or equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping up to 6".
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Housing: Heavy duty round cast iron with heavy duty cast iron coves.
6. Closure: Countersunk, Taper thread bronze plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. J.R. Smith # 4253S or equal.
9. Set cleanout flush with sidewalk grade or set in a 24" x 24" x 4" concrete pad 1 inch above finished grade. Concrete work by another section of work. Refer to Division 3.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Light Commercial Operation.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Or equal.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: As required.
7. Outlet Connection: As required.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with set-screws or other device.
10. Frame and Cover Material and Finish: Cast iron secured.

11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Finish shall match floor finish.
15. J.R. Smith # 4103SDC, #4253Sor equal.

C. Cast-Iron Wall Cleanouts :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Or equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze wall-installation frame and cover.
9. J.R. Smith #4532S or #4553S or equal.

2.4 FLOOR DRAINS AND FLOOR SINKS (See Fixture Schedule)

2.5 TRENCH DRAINS (See Fixture Schedule)

2.6 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.
   c. Or equal.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.7 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ProSet Systems Inc.
   b. 3M
   c. Or equal.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

2.8 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.

B. Floor Drain, Floor Sink, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or no-hub outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain or floor sink outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

1. 2.9 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, millphosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.11 MOTORS

A. General requirements for motors are specified in Division 22 Section 22 0513 "Motors for Plumbing."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. The University's requirements for cleanouts exceed minimum code requirements to allow for ease of maintenance and maintainability and to allow cleaning of the piping with a 50-foot snake. Cleanouts shall be provided on all floors.

D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise approved by the University's Representative:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at minimum intervals of 50 feet for horizontal piping.
3. Locate at base of each vertical soil and waste stack.
4. Locate at end of sanitary waste drains more than five feet in length.
5. Locate above sanitary tees.
6. Locate in vent piping above urinals or an end of a battery of urinals.
7. Install cleanouts flush with finished floor.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install floor drains at low points of surface areas to be drained as indicated on drawings. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains at low point of the finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

I. Install trench drains at low points of surface areas to be drained as indicated on drawings. Set grates of drains flush with finished surface, unless otherwise indicated. Care must be taken to provide adequate length to prevent drainage from escaping to lower floor.

J. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.

K. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

L. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

M. Install through-penetration firestop assemblies in stacks at floor penetrations.

N. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.

1. Position roof drains for easy access and maintenance. Are sump receivers being provided. Coordinator with architectural details for installation.

O. Assemble overflow drain fittings and install with top of water collar 2 inches above roof surface.

P. Install trap-seal primer fittings on outlet of floor drains or floor sinks that require trap-seal primer connection.

1. Exception: Fitting may be omitted if P-trap has trap-seal primer connection.
2. Size: Same as floor drain or floor sink outlet.

Q. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

R. Install reinforcement in wall for wall-mounting-type specialties.

S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

T. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Copper Sheets: Solder joints of copper sheets.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near all the equipment on the project.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section 22 0553 "Identification for Plumbing."

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1319

SECTION 22 1323 - WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of interceptors typically installed outside of the building:
   1. Grease interceptors.
   2. Fiberglass holding tanks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, sealant, and accessories.

B. Shop Drawings: For each type and size of precast-concrete interceptor or holding tank indicated.

   1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:

   1. Interceptors or holding tank.
   2. Piping connections. Include size, location, and elevation of each.
   3. Interface with underground structures and utility services.

B. Warranty: Special warranty

C. Seismic Qualification: Manufacturer’s certification of seismic qualification according to ASCE 7-05. Submit ASCE 7-05 special seismic certification as required. Include method used to determine compliance with requirements.

   1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

A. Concrete Grease Interceptors: Precast concrete complying with ASTM C 1613.

1. Basis of Design: Jensen Precast, or equal.
2. Class 1 concrete with design strength of 4500 PSI at 28 days. Unit shall be of monolithic construction at floor and wall. Unit shall be rated for H-20 loading.
3. Interceptor shall be designed for H-20-44 traffic loading as defined by AASHTO. Structural reinforcement placement shall be in accordance to ACI. All reinforcement steel shall comply with ASTM A615 grade 60 or ASTM A706 grade 60. Bar bending shall comply with latest ACI standards.
4. Lifting inserts to be installed for handling and be installed per manufacturer's requirements.
5. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
6. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
7. Sealant: A water based acrylic concrete sealant equal to ConSeal CS-55 shall be applied to all surfaces on both the interior and the exterior of the interceptor. The coating shall be factory applied, and 10-12 mils thick.
8. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover. Manhole shall be installed flush with finished grade.
9. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.

2.2 UNDERGROUND FIBERGLASS HOLDING TANKS.

A. Basis of design manufacturer: Xerxes Corporation Fiberglass reinforced plastic (FRP) tanks, or equal.

1. Capacities and characteristics shall be as stated on the drawings.
2. Tank shall be manufactured with structural ribs which are fabricated as in integral part of the tank wall.
3. Tank shall be manufactured with a laminate consisting of resin and glass fiber reinforcement only. No sand/silica fillers or resin extenders shall be used.
4. Tank shall be vented to atmospheric pressure.
5. Tank shall be capable of handling liquids with specific gravity up to 1.1.
6. Tank shall be compatible with liquids identified in the manufacturer's standard limited warranty.

B. Loading Conditions - Tank shall meet the following design criteria.

1. Internal Load - Tank shall be designed to withstand a 5-psig (35 kPa) air-pressure test with a 5:1 safety factor.
2. Surface Loads - Tank shall be designed to withstand surface H-20 and HS-20 axle loads when properly installed according to manufacturer's current Installation Manual and Operating Guidelines.
3. External Hydrostatic Pressure - Tank shall be designed for 7 feet (2.1 m) of overburden over the top of the tank, the hole fully flooded, and a safety factor of 5:1 against general buckling.

C. Fire Water Detention Applications:
1. Governing Standards, as applicable:
   a. ANSI/AWWA D120 - Thermosetting Fiberglass-Reinforced Plastic Tanks.
   b. American Concrete Institute (ACI) standard ACI 318, Building Code Requirements for Structural Concrete.
   c. Tank manufacturer shall be recognized by Underwriters Laboratories (UL) as a manufacturer of tanks listed to the UL-1316 standard.
2. Tank Design: Single-Wall as stated on the drawings.
3. Tank Accessories - Fire Water Detention Applications:
   a. Tank Anchoring:
      1) Anchor straps shall be as supplied by tank manufacturer and designed for a maximum load of 25,000 lbs.
      2) Galvanized turnbuckles shall be supplied by the tank manufacturer.
      3) Prefabricated concrete anchors shall be supplied by the tank manufacturer, designed to the ACI 318 standard, manufactured with 4,000 psi concrete and shall have adjustable anchor points.
   b. Piping and fittings:
      1) Tank shall be equipped with factory-installed threaded fittings, or pipe stubs.
      2) PVC piping shall at a minimum meet the requirements of ANSI Schedule 40.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section 31 2000 "Earth Moving."

3.2 INSTALLATION

A. Fiberglass tank shall be installed according to the tank manufacturer's Installation Manual and Operating Guidelines in effect at time of installation

B. Install precast-concrete interceptors according to ASTM C 891.

C. Comply with mounting and anchoring requirements for seismic installations.

D. Set all interceptors level and plumb.

E. Install interceptor inlets and outlets at elevations indicated on the drawings.

F. Install manhole risers from top of underground interceptors to frames and covers at finished grade.

G. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.

H. Repair and restore protective coatings to original condition.

I. Install all interceptors per the manufacturer’s recommendations.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

A. Identification materials and installation are specified in Division 31 Section 31 2000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.

1. Use warning tapes or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.5 TESTING

A. Tank shall be tested according to the tank manufacturer's Installation Manual and Operating Guidelines in effect at time of installation.

END OF SECTION 22 1323

SECTION 22 1329 – SANITARY SEWERAGE AND LAB WASTE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sewage pumps and accessories for sanitary drainage piping systems in buildings:

1. Sanitary Sewer pumps: Submersible
2. Lab Waste pumps: Vertical frame mounted.
3. Sewage/waste and lab waste pumps basins.

1.2 SUBMITTALS

A. Product Data: For each type and size of sewage pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For each sewage and lab waste pump to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sewage/lab waste pumps and are based on the specific system indicated. Refer to Division 01 Section 01 6000 "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University’s Representative, and marked for intended use.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 SE-1 SUBMERSIBLE SEWAGE/WASTE PUMPS

A. Manufacturers:
1. Weil Pump Company, Inc.
2. Goulds Pumps; ITT Industries.
3. Flygt; ITT Industries.
4. HOMA Pump Technology.
5. Or equal.

B. Submersible, Factory-assembled and tested, sewage pump unit. Each pump shall be a submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal pump as defined in ANSI HI 1.1-1.2 and HI 1.3. Capacities and characteristics shall be as scheduled on the drawings.

1. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and discharge fittings for connection to guide rail support.
2. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, non-clog, open or semi-open design for solids handling, and keyed and secured to shaft.
3. Guide-Rail Supports: Include the following for each sewage pump:
    a. Guide Rails: Vertical pipes or structural members, made of galvanized or stainless steel attached to baseplate and basin sidewall or cover.
    b. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
    c. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
    d. Sliding Pump Bracket: Constructed of heavy duty ASTM A48-53 Class 30 cast iron. The sliding bracket shall act as a wedge type coupling between the pump and stationary elbow.
    e. Stationary Elbow: ASTMA48-53 Class 30 cast iron shall be fixed and shall permit the removal of pump without disturbing the discharge piping. ANSI flange connection shall be used for connection of discharge pipe.
    f. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

C. Controls: NEMA 250, Type 12 wall mounted enclosure, pedestal-mounted float switches; with floats, float rods, and rod buttons. Include automatic alternator to alternate operation of pump units on successive cycles and to operate multiple units if one pump cannot handle load.

1. Float Guide: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.

    a. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

2.3 SE-2 VERTICAL LAB WASTE PUMPS

A. Manufacturers:

1. Weil Pump Company, Inc.
2. Gorman-Rupp
3. Zoeller Pump Company
4. Or equal.

D. Description: Factory-assembled and -tested, single-stage, centrifugal, self-priming, end-suction sewage pumps complying with UL 778. Horizontal, separately coupled, or belt-driven.

1. Pump Arrangement: Duplex.
2. Casing: Stainless, with flanged outlet connections for NPS 2-1/2 and larger discharge piping.
3. Impeller: Stainless steel statically and dynamically balanced, , and keyed and secured to shaft.
4. Pump Shaft and Sleeve Bearings: Stainless-steel shaft and ball bearings. Mechanically oil lubricated. Oil sight glasses.
5. Pump and Motor Shaft Coupling (Direct drive): Flexible, capable of absorbing torsional vibration and shaft misalignment.

E. Pump Discharge Piping: Refer to Section 22 6000 for appropriate lab waste system piping material.

F. Motor: Totally enclosed, single-speed; Comply with requirements in Division 22 Section 22 0513 "Motors for Plumbing."

1. Mounting: Vertical on base pit-mount.

G. Controls: NEMA 250, Type 12 wall mounted enclosure, pedestal-mounted float switches; with floats, float rods, and rod buttons. Include automatic alternator to alternate operation of pump units on successive cycles and to operate multiple units if one pump cannot handle load.

1. Float Guide: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.

2. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

2.4 SEWAGE PUMP BASINS

A. Description: Factory fabricated reinforced fiberglass basin, pipe connections, and separate cover.

B. Basin: Fabricate watertight, with sidewall openings for pipe connections.

1. Material: Fiberglass.
2. Reinforcement: Mounting plates for pumps, fittings, guide-rail supports, and/or accessories.

3. Anchor Flange: Same material as or compatible with basin, cast into the bottom of the basin.

C. Cover: Fabricate with openings having gaskets, seals, and bushings for inspection and access to, control rods and wiring, suction piping and vent connections.

1. Material: Stainless steel capable of supporting foot traffic.

2.5 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Flex-Hose Co., Inc.
2. Hyspan Precision Products, Inc.
3. Mercer Rubber.
4. Metraflex, Inc.
5. Or equal.

B. Description: 125-psig minimum working-pressure rating and ends matching pump connections:

1. Bronze Flexible Connectors: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing.
2. Stainless-Steel Flexible Connectors: Corrugated, stainless-steel inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to tubing.

2.6 BUILDING AUTOMATION SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for BACNET interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.
3. Sequence each pump on and off.
4. High level alarm.
5. Malfunction alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.2 INSTALLATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section 31 2000 "Earth Moving."

B. Install sewage and lab waste pumps according to applicable requirements in ANSI HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible pumps on basin floors. Make direct connections to the drainage piping

E. Mount vertical lab waste pumps from basin covers. Make direct connections to drainage piping.

F. Install fiberglass basins in accordance with manufacturer’s installation instructions and connect to drainage and vent piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor or grade. Support piping so weight of piping is not supported by pumps. Backfill in accordance with manufacturer’s instructions.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 22 Section 22 1316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to sewage pumps to allow service and maintenance.

C. Connect sanitary sewage/lab waste and vent piping to pumps and basins. Install discharge piping equal to or greater than size of pump discharge piping. Install vent piping equal to or greater than size of pump basin vent connection. Refer to Division 22 Sections 22 1316 and 22 60000.

1. Install flexible connectors adjacent to pumps in discharge piping.
2. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Sections 22 1116 and 22 6700 " for general-duty valves for sanitary/lab waste piping.

D. Ground equipment according to Division 26 Section 26 0526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section 26 0519 "Low Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Disconnect couplings and check motors for proper direction of rotation.
4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
5. Verify that pump controls are correct for required application.

B. Start pumps without exceeding safe motor power:

1. Start motors.
2. Open discharge valves slowly.
3. Check general mechanical operation of pumps and motors.

C. Test and adjust controls and safeties.

D. Remove and replace damaged and malfunctioning components.

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section 01 7900 "Demonstration and Training."

END OF SECTION 22 1329

SECTION 22 1413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following storm drainage piping inside the building and to 5 feet outside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections include the following:

1. Division 22 Section 22 1423 "Storm Drainage Piping Specialties".

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water
2. Storm Drainage, Force-Main Piping: 75 psig

B. Seismic Performance: Storm drain piping and support and installation shall be capable of withstanding the effects of seismic events determined according to CBC, Edition 2001, Seismic Zone 4 requirements.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified registered California professional engineer for selecting seismic restraints.

C. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Piping and fittings shall be manufactured in the United States, Australia, Canada or Japan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, minimum four stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Manufacturers:

1) ANACO., Husky Series SD-4000
2) Or equal.

2.4 STEEL PIPE AND FITTINGS.

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.

C. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

2.6 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.22, wrought-copper, solder-joint fittings.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.7 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.
g. Or equal.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Non-pressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Mission Rubber Co.
    c. Or equal.

2.8 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, LLDPE film of 0.008-inch minimum thickness.

B. Form: tube.

C. Color: Black.

PART 3 - EXECUTION

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping NPS 2 and larger shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
2. Steel pipe, drainage fittings, and threaded joints..
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Dissimilar Pipe-Material Couplings: Flexible, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Underground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Flexible, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Underground, storm drainage piping NPS 8 and larger shall be the following:

1. Hubless cast-iron soil pipe and fittings; shielded, stainless-steel couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Flexible, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section 33 4100 "Storm Utility Drainage Piping"

B. Basic piping installation requirements are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section 22 0548 "Vibration and Seismic Controls. For Plumbing"

D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section 22 1319 "Sanitary Waste Piping Specialties."

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

G. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

I. Install storm drainage piping at the following minimum slopes, unless otherwise approved by University’s Representative:

1. Building Storm Drain: Slope pipe at percent downward in direction of flow in accordance with CPC .requirments.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by University’s Representative.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section 22 0548 "Vibrations and Seismic Controls for Plumbing."

B. Pipe hangers and supports are specified in Division 22 Section 22 0529 "Hangers and Supports for Plumbing."

C. Install supports according to Division 22 Section 22 0529 "Hangers and Supports for Plumbing."

D. Support vertical piping and tubing at base and at each floor in accordance with CPC requirements.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:.

1. Comply with CPC Section 313, Table 313.1 and 313.6.
2. Support adjacent to a joint, not exceeding 18 inches from joint.
3. Hangers shall not be placed on couplings. Provide 3/8” rod size up to NPS 2, 1/2” rod for NPS 3, 5/8” rod for NPS 4 and NPS5, 3/4” rod for NPS 6 and 7/8” rod for NPS 8 through NPS 12.

G. Install supports for vertical cast-iron soil piping every floor to floor.

H. Install supports for vertical steel piping every floor to floor.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters in accordance with CPC Tables 313.1 and 313.6..

J. Install supports for vertical copper tubing in accordance with CPC requirements.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.8 FIELD QUALITY CONTROL

A. During installation, notify University's Representative at least 72 hours before inspection must be made. Perform tests specified below in presence of the University's Representative.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by University's Representative to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If University's Representative find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by University's Representative.

D. Test storm drainage piping according to procedures of California Plumbing Code or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. The University shall run a camera through storm piping upon substantial completion of the project. Any broken or damaged new or existing affected pipe found shall be repaired as part of the basic contract..

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1413

SECTION 22 1423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof and overflow drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves through-penetration firestop assemblies. Recommend single vendor/contractor provide all.
5. Flashing materials. Provided by roofing contractor.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company.
b. Marathon Roofing Products.
c. MIFAB, Inc.
d. Smith, Jay R. Mfg. Co.
e. Tyler Pipe.
f. Watts Water Technologies, Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
h. Or Equal.

2. Standard: ASME A112.6.4, for general-purpose roof drains.

3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Not Required.
11. Sump Receiver Plate: Required.
12. Dome Material: Rough cast-iron.
13. Perforated Gravel Guard: Not required
14. Vandal-Proof Dome: Not required.
15. Water Dam: 2 inches high for Overflow Drains.

B. Cast-Iron, Medium-Sump, General-Purpose Roof Drains: Only for smaller areas, and approved by the University Representative in writing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Tyler Pipe.
    e. Watts Water Technologies, Inc.
    f. Zurn Plumbing Products Group; Light Commercial Products Operation.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
    h. Or Equal.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: 8- to 12-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Not required.
11. Sump Receiver Plate: Required.
12. Dome Material: Roughcast-iron.
13. Wire Mesh: Not requried.
14. Perforated Gravel Guard: Not required.
15. Vandal-Proof Dome: Required.
16. Water Dam: 2 inches high for overflow drains.

C. Metal, Medium-Sump, Promenade Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Tyler Pipe.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.
    f. Or Equal.

2. Standard: ASME A112.6.4, for promenade roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: minimum **12-inch** diameter.
5. Dimension of Frame and Grate: Nominal **12 inches** square.
6. Outlet: Bottom.
7. Grate Material: Nickel-bronze alloy.
8. Vandal-Proof Grate: Required.
9. Extension Collars: Required.
10. Expansion Joint: Not required.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout nozzle:

1. Description: Manufactured, ASTM A 48/A 48M, bronze casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 outlet.

C. 2.3 CLEANOUTS

A. Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. Oatey.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.
    e. Tyler Pipe.
    f. Watts Water Technologies, Inc.
    g. Zurn Plumbing Products Group; Light Commercial Products Operation.
    h. Zurn Plumbing Products Group; Specification Drainage Operation.

i. Or Equal.

2. Standard: ASME A112.36.2M, for heavy-duty, adjustable housing] cleanouts.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule Material: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk or gasket.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round or Square.
12. Top-Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Or Equal.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soilpipe test tee as required to match connected piping.
5. Closure Plug: Countersunk brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Or Equal.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, or stainless-steel wall-installation frame and cover.

2.4 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Tyler Pipe.
    e. Watts Water Technologies, Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or Equal.

2. Standard: ASME A112.14.1, for backwater valves.
3. Size: Same as connected piping.
4. Body Material: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: hubless.
7. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field installed cleanout at floor; replaces backwater valve cover.

B. Cast-Iron, Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. Smith, Jay R. Mfg. Co.
    c. Watts Water Technologies, Inc.
    d. Zurn Plumbing Products Group; Specification Drainage Operation.
    e. Or Equal.

2. Size: Same as floor drain outlet.

3. Body Material: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded as applicable.
6. Outlet: Threaded or spigot.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES Recommend these be provided by one vendor/contractor.

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ProSet Systems Inc.
   b. Or Equal.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Insert testing agency acceptable to University Representative for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.7 FLASHING MATERIALS (PROVIDED BY OTHERS) .

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed. F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.

1. Install flashing collar or flange on roof drain with sump receiver to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout nozzle at grade with top 6 inches above grade. Secure to building wall.

D. Install cleanouts in aboveground piping on each floor and building drain piping according to the following instructions unless otherwise indicated. Provide cleanouts where required per CPC Section 707:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at maximum intervals of 100 feet.
4. Locate cleanouts at base of each vertical stack.
5. For floor cleanouts serving piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located on concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. ..Install test tees in vertical conductors' cleanouts and near floor.

G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

H. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

I. .

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

.3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1423

SECTION 221454 – RECLAIMED WATER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes a packaged domestic water treatment system. The "package" system shall be provided, installed and tested by a qualified reclaimed water system contractor/ Vendor. The package system shall consist of turnkey system for disinfection and re-pressurization as indicated on the drawings. System shall ensure disinfection with controlled injection of chemicals (user defined) via side-stream re-circulation loop, so as to maintain a residual disinfection. Disinfection equipment shall include onboard pump, two (2) bag filters with 10 and 2 micron bags respectively, and suction strainer assembly with check (foot) valve. System shall be skid-mounted and include an on-board control panel with system status indicators and alarms, with dry contacts for alarm connection to building control systems. Re-pressurization equipment shall include a duplex alternating vertical multi-stage booster pump system with integral VFD drives. System shall be complete with suction and discharge manifolds and storage tank. The collected water is then used for toilet flushing.

1.3 SUBMITTALS

A. Product Data: Include rated operating characteristics, furnished specialties, and accessories for each type of product indicated.

B. Shop Drawings: Include plans, sections, details (including dimensions and connection sizes), and attachments to other work:

1. Wiring Diagrams: Power, signal, and external control wiring.

C. Operation and maintenance data.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Systems shall be ETL approved for both US and Canada. All applicable electrical components shall be UL listed.

1.5 WARRANTY

A. Special Warranty: Vendor's standard form in which Vendor agrees to repair or replace equipment that fails in materials or workmanship within specified warranty period.
   1. Limited Warranty Period: 1 year from date of system startup. Consult operations manual for full warranty details.

PART 2 - PRODUCTS

2.1 PACKAGED DOMESTIC WATER TREATMENT SYSTEM

A. Vendor's: Subject to compliance with requirements, provide products by one of the following:

B. Experience: The Vendor shall have more than five years' experience with water filtration, chemical injection, and pumping systems.
Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
   1. Water Control Corporation (Ramsey, MN).
   2. Approved Equal.

D. The same Vendor shall be used for the complete system including chemical injector, filtration equipment, pumps, and skid.

2.2 SYSTEM CONSTRUCTION:

A. The domestic water treatment system shall consist of enclosed (2) chemical injection pumps/injection equipment, 2 HP side-stream circulation loop pump, 10 and 2 micron basket filters in 150 psi rated stainless steel housing, control panel with LED system status indicators in NEMA 3R enclosure, and sampling cocks, all mounted on powder-coated aluminum skid.

2.3 MECHANICAL FEATURES:

A. The domestic water treatment system shall disinfect stored water via side stream circulation and chemical injection. Water shall be circulated from tank, into skid system. Chemicals (user defined) shall be injected into circulated water, which shall then be returned to tank. ORP (Oxygen Reduction Potential) meter located on pump suction inlet shall take constant tank oxidation measurements and cycle chemical injection equipment/pump on and off as necessary in order to maintain a residual disinfection in storage tank. Recirculation pump shall filter water through on-board 10 and 2 micron bag filters.

2.4 CONNECTIONS:

A. All piping to and from cistern tanks and domestic water treatment system shall be Schedule 80 PVC. See drawings for connection sizes and locations.

2.5 CONTROLS AND FAIL-SAFE MECHANISMS

A. System shall include on-board electronic controller in NEMA 3R enclosure, with LED system and tank status displays. Controller shall monitor at all times tank water level, tank ORP levels, pump temperatures, and pressure differential through bag filters. Should tank water level drop to suction inlet level, controller shall initiate potable water make-up. Chemical disinfection system shall come online at a programmable interval to disinfect tank water. Should ORP levels in tank drop such that chemical concentrations have fallen, controller shall cycle chemical system on to rebuild concentrations. Should pressure differential through bag filters exceed 9 psi, controller shall indicate that bag filters require changing. Controller shall also monitor pump temperatures to indicate when pumps require re-priming, or strainers require cleaning. Status of all fail-safe functions shall be clearly displayed on LED control panel. System shall include fail-safe alarm light with dry contacts for connection to building monitoring system.

2.6 PERFORMANCE

A. Disinfection levels: The system shall maintain and monitor tank water disinfection levels via ORP (oxygen reduction potential) meter. ORP levels shall be displayed on system control panel.

B. Tank water levels: The system shall monitor tank water levels via tethered mechanical float switch. Tank levels shall not be allowed to drop to lower than suction inlets. If tank water level approaches suction inlet level, potable water make-up shall be initiated in order to maintain suction pump prime

C. Pump temperatures: The system shall monitor pump operating temperatures. If pumps should overheat, system shall revert to standby mode with alarm and indicator light activated.

D. Pressure loss through filters: The system shall monitor pressure differential across any on-board filter housings. If at any time, pressure differential should exceed 9 psid, alarm shall be activated until filters have been serviced.

E. Temperature requirements: Ideal system operating temperatures shall be 50°- 75°F. Minimum operating temperature shall be 35°F. Maximum operating temperature shall be 100°F. System shall not be subjected to freezing temperatures.

2.7 ACCESSORIES

A. Storage tank: Molded polyethylene horizontal or vertical liquid storage tank, by Norwesco, or equal.

B. Booster pump system: Shall be a duplex alternating vertical multi-stage pump package. Pumps shall include an integral VFD drive and communication cable. System shall be skid mounted and include stainless steel suction and discharge manifolds.

C. Fresh water by-pass: Shall be installed on the downstream side of the booster pump system and shall consist of reduced pressure zone assembly, pressure reducing valve, two check valves. PRV to be set 5 to 10 PSI below the booster pump set pressure.

D. Vendor's: Subject to compliance with requirements, provide products by one of the following

E. Experience: The Vendor shall have more than five years' experience with water filtration, chemical injection, and pumping systems. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Water Control Corporation (Ramsey, MN).

2. Approved equal.

3. The same Vendor shall be used for the complete system including chemical injector, filtration equipment, pumps, and skid.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Install domestic water treatment system: Packaged treatment system with side-stream circulation/chemical injection system, on-board filtration, pressure pump, pressure tank with pressure switch, controls, fail-safe systems, storage tanks, pre-filters, and accessories.

3.2 INSTALLATION

A. Install domestic water treatment system according to the drawings and the Vendor's instructions. The installer shall be responsible for providing a functional system, installed in accordance with applicable national and local requirements.

B. Install and secure storage tanks per Vendor's instructions. Consult Vendor's to determine optimal inlet/outlet connection locations. Above ground tanks shall be mounted on poured concrete base. Tank overflow(s) shall run to storm sewer/grade per civil engineer instructions.

C. Install sanitation and re-pressurization system for domestic water.
1. Install skid system on concrete pad in mechanical room or other location providing protection from freezing and other harmful elements.
2. Connect suction strainers to tank outlets on inside of tank, with check (foot) valves located on exterior side of tank outlets. Suction strainers should be minimum 6" from tank bottom, where possible. Where necessary, consult Vendor to determine optimal configuration.

3. Connect system suction inlets to suction strainer outlets -- and chemical circulation return outlet to cistern tank using Schedule 80 PVC. Chemical circulation return line should be minimum 25' in length to ensure adequate oxidation (snake pipe if necessary to achieve distance).
4. Tether tank float to tank top per Vendor instructions.

D. Electrical Connections and Grounding: System requires separate sources of power;
1. 460/230-208 Volts 3 Phase power for the disinfection system pump.
2. 120 Volts single phase for the System Control and Disinfection apparatus.
3. 460/230-208 Volt 3 Phase power for the booster pump system.
4. Power lines shall be supplied from a building service box, which includes proper connections and circuit breakers with quick disconnection mechanism, and sized according to system requirements (see drawings). Wiring shall conform to local electrical codes and requirements and must be performed by a licensed electrical contractor. Electrical inspection shall be performed, and inspection notice approved, by an authorized approval agency.

E. Authorized factory representative shall perform final (on-site) system activation, calibration, and training.

3.3 FIELD QUALITY CONTROL

A. Verification: Authorized Vendor representative shall provide final inspection and verification of system installation and operation.

3.4 PIPING SCHEDULE

A. Above ground reclaimed water piping system shall be as specified in Division 22 Section 22 1116 "Domestic Water Piping and Valves"

3.5 PIPING INSTALLATION

A. Copper pipe and tube shall be installed as described in Division 22 Section 22 1116 "Domestic Water Piping and Valves".

B. Reclaimed water piping shall be wrapped or painted purple and labelled in accordance with requirements described for chapter 16A Non-Potable Water Reuse Systems of the 2013 California Plumbing Code.

END OF SECTION 221454

22 1513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 125 psig and less.

B. Related Sections include the following:

1. Division 22 Section 22 0516 "Meters and Gages for Plumbing" for thermometers and pressure gages.
2. Division 22 Section 22 1519 "General-Service Packaged Compressed-Air Equipment" for compressed-air equipment and accessories.
3. Division 22 Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for piping support requirements.

1.2 DEFINITIONS

A. Retain abbreviations and definitions that remain after this Section has been edited. Compressed Air Piping: System of compressed-air piping and specialties operating at pressures of 125 psig and less.

B. NBR: Acrylonitrile-butadiene rubber.

C. PE: Polyethylene plastic.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Pipes, tubes, and fittings.
2. Flexible pipe connectors.
3. Safety valves.
4. Pressure regulators.

B. Coordination Drawings: For compressed-air systems. Include relationship to other services that serve same work area.

C. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

D. Welding Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

C. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES, TUBES, AND FITTINGS

A. Copper Tube: ASTM B 88, Type L, seamless, drawn-temper, water tube. All piping and fittings shall be cleaned for oxygen service prior delivery on site and installation. Bag fittings and cap pipe ends.

1. Wrought-Copper Fittings: ASME B16.22, wrought solder-joint pressure fittings or ASME B16.50 wrought copper braze joint fittings; braze joints in accordance with MSS SP-73, silver brazing joints for wrought copper with dimensions for brazed joints.

2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300. Provide Class 300 if indicated.
3. Copper Unions: ASME B16.22 or MSS SP-123.

2.4 JOINING MATERIALS

A. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for joining materials not in this Section.

1. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4

2.5 VALVES

A. Ball Valves: (NPS 1/2– NPS 2-1/2)

1. Three-Piece, copper-alloy, NFPA-99, Bronze body with full-port, chrome plated brass ball and stem PTFE seats, cleaned for medical gas service with end capped and bagged; and 600-psig minimum CWP rating and blowout-proof stem.

a. Amico Corporation
b. Conbraco Industries, Inc.; Apollo Div., brazed only.
c. Or equal.

B. Check Valves: (NPS 1/4 - NPS 1-1/2)

1. Bronze, threaded, and rated at 150 psi at 200°F.

a. Lift check valves for use in compressed air piping shall be based on Spirax-Sarco Model No. LCV1 or equal.

2.6 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.

B. Air Line Pressure Regulators: Brass and bronze construction, with gauge or gauge ports, spring-loaded manual pressure-setting adjustment, factory cleaned for oxygen, minimum rated for 250 psig inlet pressure.

1. Type: Pilot operated or direct acting.

Manufacturers:

a. BeaconMedaes
b. Norgren.

c. Ingersol Rand.
d. Or equal.

2.7 IDENTIFICATION

A. Refer to Division 22 Section 22 0553 "Identification for Plumbing" for identification of piping, valves, gages, and specialties.

PART 3 - EXECUTION

3.2 PIPING APPLICATIONS

A. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below, unless otherwise indicated.

B. Joining of Dissimilar Metal Piping: Use dielectric isolation fittings. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for dielectric fitting types and requirements. Dielectric unions shall not be used on Campus.

C. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.

D. Compressed-Air Distribution Piping: Use the following piping materials:

1. ASTM B 88, Copper tube, wrought-copper fittings, and brazed joints.

a. Aboveground: Type L.

3.3 VALVE APPLICATIONS

A. General-Duty Valves:

1. Shut-off: Three-piece ball valve on main and branch piping.
2. Check Valve: Lift Check.

3.4 PIPING INSTALLATION

A. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for basic piping installation.

B. Install a ball valve and a flexible pipe connector on each connection to air compressors, or equipment.

C. Install pipe expansion joints and anchors according to Division 22 Section 22 0516 "Expansion Fittings and Loops for Plumbing."

D. Pressure test entire piping system at 150 psig, or 150-percent of system pressure, whichever is greater for four hours. Check each joint for leaks with soap – repair detected leaks. For system to be acceptable, the piping system shall retain pressure for test period duration.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for basic piping and valve installation.

B. Install valves according to manufacturer's written instructions.

C. Install shutoff valve at each connection to and from general-service compressed-air specialties, equipment, and accessories. Install strainer if indicated.

D. Install shutoff valves at inlet of pressure regulators. Install pressure gages at inlet and outlet of pressure regulators located in lower level interstitial. Provide gage ports at inlet and outlet of pressure regulators at all other locations.

E. Install check valves to maintain correct direction of fluid flow to and from compressed-air piping specialties and equipment.

F. Install safety valves where recommended by specialty manufacturers.

G. Install sectional shutoff valves in branch piping systems at mains to allow portions of the distribution piping to be shut down without requiring a major shutdown.

3.6 JOINT CONSTRUCTION

A. Refer to Division 22 Common Work Results for Plumbing" for basic piping joint construction.

B. Join copper tubing by brazed joints under continuous nitrogen purge. Use silver-composition or copper-phosphorus composition filler metal as indicated in Section 22 0500 "Common Work Results for Plumbing".

C. Dissimilar Metal Piping Material Joints: Use dielectric fittings. Dielectric Unions shall not be used. Refer to Section 22 0500 "Common Work Results for Plumbing".

3.7 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Refer to Division 22 Section 22 0529 "Hangers and Supports for Plumbing" for pipe hanger and support devices.

C. Install supports according to Division 22 Section 22 0529 "Hangers and Supports for Plumbing."

D. Support horizontal piping within 12 inches of each fitting and coupling.

E. Support vertical piping and tubing at base and at each floor.

F. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

G. Install hangers for copper tubing in accordance with CPC requirements.

H. Install supports for vertical copper tubing in accordance with CPC requirements.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to specialties and equipment to allow service and maintenance.

C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

3.9 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping systems. Refer to Division 22 Section 22 0553 "Identification for Plumbing" for labeling and identification materials.

3.10 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours without drop in pressure.

    a. Repair leaks and retest until no leaks exist.

3. Report results in writing.

END OF SECTION 22 1513

SECTION 22 1519 - GENERAL SERVICE PACKAGED AIR EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following general-service compressed-air equipment and related accessories:

1. Air compressors with integral intercoolers, aftercoolers, intake filters and controls.
2. Receivers.
3. Compressed-air dryers.

B. Related Sections include the following:

1. Division 22 Section 22 1513 "General-Service Compressed-Air Piping" for compressed-air piping, valves and related specialties.

1.2 DEFINITIONS

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

B. Standard Air: Free air at 68 deg F and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following compressed-air equipment:

1. Air compressors with integral intercoolers, after coolers, intake filters and controls.
2. Receivers.
3. Compressed-air dryers.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Wiring Diagrams: Power, signal, and control wiring.

C. Product Certificates: Certificates of shop inspection and data report for receiver tanks as required by ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Qualification Data: For Installer.

E. Startup service reports.

F. Operation and Maintenance Data: For the following compressed-air equipment and accessories to include in emergency, operation, and maintenance manuals:

1. Air compressors.
2. Compressed-air dryers.

G. Certified test data, performance curves, and spare parts lists are to be included in the Operation and Maintenance Manuals (O&M).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of compressed-air equipment manufacturer for both installation and maintenance of units required for this Project.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of compressed-air equipment and are based on the specific system indicated. Refer to Division 01 Section 01 6000 "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70, Article 100), by a testing agency acceptable to University's Representative, and marked for intended use.

D. ASME Compliance: Fabricate and label receiver tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with CEC (NFPA 70), "National Electrical Code."

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing" for concrete bases. Refer to Division 03 Section 03 3000 "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000"Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 AIR COMPRESSOR SYSTEM

A. General Description: Duplexed compressor and dryer system. Base frame mounted compressors, sound insulated painted steel enclosure with removable hinged access doors for ease of maintenance. Each compressor factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty type that delivers 100% oil-free air. Refer to equipment schedule for capacities and model.

1. Manufacturers:
   a. Allied Healthcare Products, Inc., Gardner Denver EnviroAire
   b. Ingersol Rand, Air Compressor Div.
   c. Quincy Compressor.
   d. Or equal.

D. Compressor: Positive displacement, single-stage, oil-free, rotary screw type, housing, one-piece bronze main rotor, carbon fiber composite gate rotors, and shafts, precision timing gears, anti-friction bearings, speed increaser with thrust cancelling bull gear, self-adjusting ring seals, sealed oil-free bearings, integral air-cooled intercooler and aftercooler, cooling fan, auto-drain. Flexible coupled TEFC motors for compressor, oil pump and fan. Integral oil lubrication sump with gear drive oil pump, pressure regulating system, load-unload capacity control valve with muffler, safety pressure relief valve.

E. Controls: Integral with compressor enclosure. Allen Bradley PLC automatic controls with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Mounting and Wiring: Factory installed and connected as an integral part of equipment package.
2. Enclosure: NEMA ICS 6, Type 12 control panel minimum.
3. Motor Controllers: Variable frequency drive, Full-voltage, combination-magnetic type with under voltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.

   a. Control Voltage: 120-V ac or less, using integral control power transformer.
   b. Motor Overload Protection: Overload relay in each phase.
   c. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.

      1) Automatic controls for alternating lead-lag compressors for duplex operation.

4. Instrumentation: Operator interface touch screen to include intake air and oil filter conditions, routine maintenance indicators, first and second stage temperatures and

pressures, oil level, temperature and pressure, run time, power and run indicators, cooling fan indicator, alarm indicator and buzzer with cancel switch, motor overloads, etc.

5. BACNET capable for connection to building management system to remotely monitor compressor system.

F. Motors: General requirements for motors are specified in Division 22 Section 22 0513 "Motors for Plumbing."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

G. Receivers: Vertical steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1; rated for working pressure at least as high as highest discharge pressure of connected compressors; and bearing appropriate code symbols. Include safety valve, pressure gage, automatic drain, and pressure-reducing valve.

H. Fabricate base and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.6 COMPRESSED-AIR DRYERS

A. Desiccant-Type Dryers: Twin-tower unit with purge system, mufflers, and capability to deliver plus 10 deg F, 100-psig air at dew point. Include dew point controlled purge, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

1. Manufacturers:

a. Allied Healthcare Products, Inc.
b. Rotary Atlas Copco
c. Ingersoll-Rand Company; Air Compressor Group.
d. Wilkerson Corp.
e. Zeks Air Drier Corporation.
f. Or equal.

2. Capacity: Match maximum capacity of connected air compressor.
3. Inlet Filter: 5 microns.
4. Outlet Filter: 1 micron(s).

2.7 ACCESSORIES AND OPTIONS

A. General: Include accessories with working-pressure rating not less than system pressure at location where used, and compatible with equipment and piping system used.

2.8 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Automatic Drain Valves: Electrical operation type with corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

C. Pressure Regulators: Stainless Steel or Bronze body, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Type: Diaphragm or pilot operated.

D. Pressure Regulators: Aluminum alloy or Stainless steel body, diaphragm operated, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated. E. Compressed-Air Filters:

1. Manufacturers:

a. Allied Healthcare Inc.
b. Arrow Pneumatics, Inc.
c. Ingersoll-Rand Company; Air Compressor Group.
d. Wilkerson Corp.
e. Zeks Air Drier Corporation.
f. Or equal.

2. Mechanical-Separation Filters: Two-stage air-line filters of capacity not less than that of connected equipment. Equip with deflector plates; resin-impregnated-ribbon-type filters with edge filtration, 10 micrometers thick; and drain chock.
3. Coalescing Filters: Capacity not less than that of connected equipment; with color change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Equip with activated carbon capable of removing water and oil aerosols.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Install concrete bases for compressed-air equipment. Concrete base is specified in Division 22 Section 22 0500 "Common Work Results for Plumbing," and concrete materials and installation requirements are specified in Division 03.

3.2 EQUIPMENT INSTALLATION

A. Install air compressors on concrete bases. Install units level, plumb, and anchored to substrate in locations indicated. Maintain manufacturers' recommended clearances. Orient equipment so controls and devices are accessible for servicing.

1. Anchor packaged equipment to concrete base.

a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
b. Install epoxy-coated anchor bolts for supported equipment; extend through concrete base and anchor into structural concrete floor.
c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
d. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Vibration Isolation: Install restrained spring isolators with a minimum deflection of Vibration isolation devices and installation requirements are specified in Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing."

C. Vibration Isolation: Mount equipment with motors larger than 5 hp on vibration isolation equipment base as specified in Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing."

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
3. Automatic Drain Valves: Install on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect piping to air compressors and receivers, except safety relief valve connections, with flexible pipe connectors of materials suitable for service. Flexible pipe connectors and their installation are specified in Division 22 Section 22 1513 "General-Service Compressed-Air Piping."

D. Ground equipment according to Division 26 Section 26 0526 "Grounding and Bonding for Electrical Systems."

E. Connecting of wiring under another scope of work. Refer to Division 26 Section 26 0519 "Low Voltage Electrical Power Conductors and Cables."

F. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for compressed-air equipment. Refer to Division 22 Section 22 0553 "Identification for Plumbing" for labeling and identification materials.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to test, inspect, and adjust components and equipment installation and to perform startup service.

B. Perform the following final checks:

1. Verify that specified tests of piping systems are complete.
2. Verify that potable-water supply connections to equipment have correct backflow preventer.
3. Check for piping connection leaks.
4. Check for lubricating oil in lubricated-type equipment.
5. Check belt drives for proper tension.
6. Verify that air-compressor inlet filters and piping are clear.
7. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
8. Check safety valves for correct settings. Ensure that settings are greater than air compressor discharge pressure but not greater than rating of system components.
9. Check for proper seismic restraints.
10. Test operation of equipment safety controls and devices.
11. Drain receiver tanks.

C. Verify that compressed-air equipment is installed and connected according to the Contract Documents.

D. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in Division 26 Sections.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Complete installation and startup checks according to manufacturer's written instructions.

H. Prepare written report documenting testing procedures and results.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain general-service compressed-air equipment. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 1519

SECTION 22 1613 – FACILITY NATURAL GAS DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following for natural gas distribution outside the building:

1. Piping.
2. Valves.
3. Regulators.
4. Concrete bases.

B. Related Sections include the following:

1. Division 22 Section 22 1616 "Fuel Gas Piping" for natural gas piping inside the building.
2. Division 23 Section "Instrumentation and Controls" for natural gas meters control connection.

1.2 DEFINITIONS

A. Gas Distribution: Piping branch off from UCIR site main to individual UCR re-charge meter at or in building and gas shut-off valves.

B. Gas Meter Assembly: Piping, valves, regulator, meter and earthquake valve and specialties.

C. Point of Delivery: Piping outlet from service-meter assembly or connection to existing University gas piping.

D. Natural Gas Piping: Piping that conveys natural gas from point of delivery to natural gas utilization devices inside the building. G. PE: Polyethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working-Pressure Ratings:

1. Piping and Valves: 80 psig minimum, unless otherwise indicated.
2. Regulators: 100 psig minimum, unless otherwise indicated.
3. Meters: 20 psig minimum, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Pipe and fittings.
2. Valves.

B. Shop Drawings: For natural gas service piping including earthquake valves. Include plans, elevations, sections, details, and attachments to other work.

C. Welding certificates.

D. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. HDPE Fusion Welding: Follow pipe manufacturers guidelines for butt fusion welding and fusion coupling install.

B. Comply with requirements of utility supplying natural gas (The Gas Company) and with University's Representative for natural gas systems.

C. Comply with ANSI Z223.1, ASME B31.8 and AGA IFGC for materials, installation, testing, inspection, and purging.

D. Design shall be based on pressure at regulator and CPC sizing parameters.

E. Preinstallation Conference: Conduct Conference at the Project Site to comply with requirements of Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle liquids to avoid spillage and ignition. Do not leave flammable liquids on premises overnight.

B. Store PE pipes and valves protected from direct sunlight.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural Gas Service: Do not interrupt natural gas service to facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide purging and startup of gas supply according to requirements indicated:

1. Notify University's Representative no fewer than two weeks in advance of proposed interruption of natural gas service.

2. Do not proceed with interruption of natural gas service without University's written permission.

1.8 COORDINATION

A. Coordinate connection to gas main with utility (The Gas Company), if applicable or with University's Representative if University piping system.

B. Coordinate natural gas distribution with other utility Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPES AND FITTINGS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

B. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B; Schedule 40, black.

1. Malleable-Iron Fittings: ASME B16.3, Class 150, standard pattern, with threads complying with ASME B1.20.1.
2. Steel Fittings: ASME B16.9, wrought-steel butt-welding type; and ASME B16.11, forged steel.
3. Steel Flanges and Flanged Fittings: ASME B16.5.
4. Unions: ASME B16.39, Class 150, black malleable iron; female pattern; brass-to-iron seat; ground joint.

C. PE Pipe: ASTM D 2513, SDR 11, SDR 11.5. HDPE coil or individual straight pipe are permitted.

1. PE Fittings: ASTM D 2683, socket type or ASTM D 3261, butt type with dimensions matching ASTM D 2513, SDR 11, SDR 11.5 PE piping.

D. Transition Fittings: Manufactured pipe fitting with one PE pipe end for heat-fusion connection to PE pipe and with one ASTM A 53/A 53M, Schedule 40, steel pipe end for threaded connection to steel pipe.

E. Service-Line Risers: Manufactured PE pipe fitting with PE pipe inlet for heat-fusion connection to underground PE pipe; PE pipe riser section with protective-coated, anodeless, steel casing and threaded outlet for threaded connection to aboveground steel piping.

2.3 JOINING MATERIALS

A. Components, Tapes, Gaskets, and Bolts and Nuts: Suitable for natural gas and as recommended by piping manufacturer.

2.4 SHUTOFF VALVES

A. Shutoff Valves, General: Manual operation, suitable for natural gas service, and with 100psig minimum working-pressure rating.

B. Threaded Valves, NPS 1 and Smaller: Include listing by American Gas Association.

C. Ball Valves: Bronze body, with stainless steel ball and stem; lever handle; and complying with ASME B16.33, MSS SP-110, UL 842.

1. Manufacturers:

a. Apollo/Conbraco Industries, Inc.# 77-140. (Campus Standard)
b. Or equal (no known equal).

D. Non-lubricated Plug Valves: Cast-iron body, with resilient-coated eccentric plug; lever operation; and complying with ASME B16.38, MSS SP-108, and UL 842. Include locking device.

1. Manufacturers:

a. Milliken Valve Co., Inc.
b. Olson Technologies, Inc.; Homestead Valve Div.
c. Pratt, Henry Co.
d. SPX Corporation; DeZURIK Unit.
e. Or equal.

E. PE Valves: Made for gas distribution, with nut or flat head for key operation; and complying with ASME B16.40, UL 842.

1. Manufacturers:

a. Kerotest Manufacturing Corp.

b. Nordstrom Valves, Inc.
c. Perfection Corporation; Gas Products Div.
d. Or equal.

F. Valve Boxes: Cast-iron, two-section box. Include top section with cover with "GAS" lettering, bottom section with base to fit over valve and barrel 5 inches in diameter, and adjustable cast-iron extension of length required for depth of bury. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head and with stem of length required to operate valve.

2.5 MISCELLATNEOUS MATERIALS

A. Warning Tapes: See Division 31 Section “Earth Moving”. Tapes shall state “Caution” Gas Line Buried Below”.

B. Tracer Wire: See Division 31 Section “Earth Moving”.

C. Corrosion Protection: ASTM A 674 or AWWA 6105, PE film, 8 mil minimum, tube or sheet. "Not required on plastic pipe or plastic coated steel pipe."

2.6 CONCRETE BASES

A. Description: Concrete made of 3000-psi- minimum, 28-day compressive strength reinforced concrete; at least 4 inches thick and 4 inches larger in each dimension than supported item.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PREPARATION

A. For existing buildings, close equipment shutoff valves before turning off gas to premises or piping section.

B. Inspect natural gas piping according to fuel gas code to determine that natural gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54, fuel gas code requirements for prevention of accidental ignition.

D. Pipe and fittings shall be free from burrs and fins.

3.3 PIPING APPLICATIONS

A. Flanges, unions, and transition and special fittings with pressure ratings same as or higher than system pressure rating may be used.

B. Aboveground Piping:

1. NPS 2 and Smaller: Steel pipe, malleable-iron fittings, and threaded joints.
2. NPS 2-1/2 and Larger: Steel pipe, butt-welding-type fittings, and welded joints. Joints for connection to service regulators, meters, and valves with flanged connections may be flanged. Joints for connection to regulators, meters, and valves with threaded connections NPS 2-1/2 to NPS 4 may be threaded.

C. Underground Piping: PE pipe, PE fittings, and heat-fusion joints.

D. Provide shut off valve at the point of connection to existing piping.

E. Underground-to-Aboveground Piping Connections: Service-line riser.

F. PE-to-Steel Piping Connections: Transition fitting.

3.4 VALVE APPLICATIONS

A. Types of shutoff valves to be used shall comply with the following requirements:

1. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping gas mains.
2. Underground: Use PE valves.
3. Aboveground, NPS 2 and Smaller: Ball valves.
4. Aboveground, NPS 2-1/2 and Larger: Non-lubricated plug valves.

3.5 PIPING INSTALLATION

A. Install underground, natural gas distribution piping buried at least 30 inches below finished grade.

B. Install underground, PE, natural gas distribution piping according to ASTM D 2774.

C. Natural gas piping shall not be installed under any part of building.

D. Install double wrap of PE corrosion protection on all buried metallic pipe and fitting.

E. Drips and Sediment Traps: Install drips at points where condensate may collect, including meter outlets and drops at each appliance or equipment. Locate where readily accessible to permit cleaning and emptying.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and

same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

F. Terminate regulator horizontal vents or horizontal vent piping with reducing-elbow fittings with large end as outlet at the exterior of building. Install fitting outlet turned down with corrosion-resistant insect screen in outlet.

3.6 VALVE INSTALLATION

A. Install PE shutoff valves on branch connections to existing underground, natural gas distribution piping. Install valves with valve boxes.

B. Install metal shutoff valves on aboveground, natural gas distribution piping.

C. Install earthquake valves aboveground, outside building, and according to listing applications.

3.7 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing." for basic piping joint construction.

3.8 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with requirements specified. Connect gas distribution piping to natural gas source and extend to meter assemblies and points indicated. Connect to building's natural gas piping if it is installed; otherwise, terminate piping with caps, plugs, or flanges, as required for piping material. Refer to Division 22 Section "Fuel Gas Piping" for natural gas piping inside the building.

B. Install unions, in above ground piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.

C. Install flanges, in above ground piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

D. Do not use natural gas distribution piping as grounding electrode.

3.9 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each regulator, meter, and earthquake valve.

1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

B. Refer to Division 22 Section "Common Work Results for Plumbing" for equipment nameplates, signs, and tracer wire.

C. Warning Tapes: Arrange for installation of continuous, underground, warning tape over natural gas distribution piping during backfilling of trenches for piping.

D. Tracer Wire: Install strapped to underground piping at 10'-0" on centers and terminating above ground at entrance to building.

E. Refer to Division 31 Section "Earth Moving" for warning tapes.

3.10 PAINTING

A. All painting, with exception of touch up, provided under another division scope of work.

3.11 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving". Arrange for installation of yellow warning tape directly over piping and installation of tracer wire.

1. Use warning tape over all piping.
2. Use tracer wire over nonferrous piping.

3.12 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas distribution according to requirements of fuel gas code and University's Representative.

B. Repair leaks and defective valves and specialties and retest system until no leaks exist.

C. Report results in writing.

D. Verify correct pressure settings for service regulators.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain earthquake valves. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 1613

SECTION 22 1616 - FUEL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes fuel gas piping outside and within the building. Products include the following:

B. Adjust list below to suit Project.

1. Pipe, tube, fittings, and joining materials.
2. Protective pipe and fitting coating.
3. Piping specialties.
4. Specialty valves.
5. Recharge meters.
6. Pressure regulators.
7. Earthquake valves.
8. Laboratory Safety Device System (Emergency Gas Shutoff)

1.2 DEFINITIONS

A. CBC: California Building Code.

B. CPC: California Plumbing Code.

C. NFPA: National Fire Protection Agency.

D. PE: Polyethylene plastic.

1.3 PROJECT CONDITIONS

A. Gas System Pressures: Two pressure ranges. Primary pressure is more than 2.0 psig but not more than 5.0 psig, and is reduced to secondary pressure of more than 0.25 psig but not more than 2.0 psig.

B. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu. ft.
2. Nominal Specific Gravity: 0.6.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
2. Recharge-meter bars. Include Recharge-meter size of selected models.
3. Recharge meters. Include pressure rating and capacity of selected models.
4. Recharge-meter bypass fittings.
5. Pressure regulators. Include pressure rating, capacity, and settings of selected models.
6. Earthquake valves.
7. Wiring Diagrams: Power, signal, and control wiring
8. Laboratory Safety Device System.

B. Welding certificates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For natural gas specialties and accessories to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding: Qualify processes and operators per ASME Boiler and Pressure Vessel Code: Section IX.

B. Electrical Components and Devices: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University's Representative, and marked for intended use; alarm devices in accordance with NFPA 72 National Fire Alarm Code.

C. Code: Comply with California Building Codes (CBC and CPC), NFPA 54.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: For modification of existing systems, remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day. B. Store PE pipes and valves protected from direct sunlight.

B. Products and Devices shall be kept clean, dry and protected from all damage, including that due to weather, humidity and construction traffic.

C. All handling and storage procedures shall comply to the manufacturer's recommendations.

1.7 COORDINATION

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

B. Notify University's Representative not less than two weeks in advance of proposed utility interruptions.

1. Do not proceed with utility interruptions without University's Representative written permission.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified, or equal.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000 "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

A. Steel Pipe: ASTM A 53/A 53M; Type E or S; Grade B; Schedule 40 black. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.

6. Joint Compound and Tape: Suitable for natural gas.
7. Steel Flanges and Flanged Fittings: ASME B16.5.
8. Gasket Material: Thickness, material, and type suitable for natural gas.

B. Transition Fittings: Manufactured pipe fitting with one PE pipe end for heat-fusion connection to PE pipe and with one ASTM A 53/A 53M, Schedule 40, steel pipe end for threaded connection to steel pipe.

C. Service-Line Risers: Manufactured PE pipe fitting with PE pipe inlet for heat-fusion connection to underground PE pipe; PE pipe riser section with protective-coated, anode less, steel casing and threaded outlet for threaded connection to aboveground steel piping.

2.4 PROTECTIVE COATING

A. Furnish for underground steel pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in contact with materials that may corrode the pipe.

2.5 PIPING SPECIALTIES

A. Flexible Connectors: ANSI Z21.24, stainless steel metal connectors for gas appliances.

B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connectors.

2.6 SPECIALTY VALVES

A. Valves, NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

B. Valves, NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges.

C. Valves in category below are limited to 0.5 psig (3.45 kPa), are used for shutoff service to appliances, and are NPS 3/4 (DN 20) and smaller.

D. Appliance Connector Valves: ANSI Z21.15 and CSA International listed.

1. Manufacturers:

a. American Valve Inc.
b. B&K Industries, Inc.
c. Conbraco Industries, Inc.; Apollo Div.
d. JMF Company
e. Fisher Controls International, Inc.
f. Jomar International Ltd.
g. Key Gas Components, Inc.
h. Legend Valve and Fitting, Inc.
i. McDonald, A. Y. Mfg. Co.
j. Mueller Co.; Mueller Gas Products Div.
k. Robert Manufacturing Co.

l. State Metals, Inc.
m. Watts Industries, Inc.; Water Products Div.
n. Or equal.

E. Gas Stops: Size, 2" and below, bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle; 2-psig minimum pressure rating.

F. Ball valves, NPS 2 and Smaller: ASME B16.33 and CSA International-listed bronze body and 125-psig pressure rating.

1. Manufacturers:

a. Conbraco Industries, Inc., Apollo Div.
b. Crane Valves.
c. Flow Control Equipment, Inc.
d. Honeywell International Inc.
e. Jomar International Ltd.
f. Lyall, R. W. & Co., Inc.
g. McDonald, A. Y. Mfg. Co.
h. Milwaukee Valve Company.
i. Mueller Co.; Mueller Gas Products Div.
j. NIBCO INC.
k. Velan Inc.
l. Watts Industries, Inc.; Water Products Div.
m. Or equal.

2. Tamperproof Feature: Include design for locking.

G. Gas Solenoid Valves, NPS 2 and Smaller: UL listed and CSA International-certified brass, bronze or stainless body suitable for natural gas and 125-psig pressure rating.

1. Manufacturers:

a. Emerson ASCO Redhat.
b. Magnatrol Valve Corp.
c. Jefferson Solenoid Valves USA, Inc.
d. Or equal.

H. Plug Valves, NPS 2-1/2 and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.

1. Manufacturers:

e. Flow Control Equipment, Inc.

f. Milliken Valve Co., Inc.
g. Nordstrom Valves, Inc.
h. Olson Technologies, Inc.; Homestead Valve Div.
i. Walworth Co.
j. Or equal.

2. Tamperproof Feature: Include design for locking.

I. Earthquake Valves: Listed in CSA International's "Certified Product Listing Directory: Components for Gas and Electrical Equipment" as complying with ASCE 25 and UL listed. The valves shall be certified by California, Division of the State Architect.

1. Earthquake-Valve: Working-pressure rating is 25 psig. Cast-aluminum body with stainless-steel internal parts. Buna-N, reset-stem, O-ring seal. Threaded end connections.
2. Manufacturers:

a. Safe T Quake Corp.
b. California Koso.
c. Or equal.

2.7 GAS METERS

A. University Recharge Meters: For gas service extended from University Mains on Site to the project site. Coordinate with Facilities. Provide site main, gas pressure regulator, recharge meter and earthquake safety valve.

1. Recharge Gas Meters.
2. Gas meter assemblies shall conform to the requirements of ANSI B109 Metering Standards.
3. Recharge Gas Meters, General: Positive-displacement gas meter.

a. Construction: Metal case with temperature compensation, and corrosion-resistant internal components.
b. Pipe Connections:

1) NPS2 and Smaller: Threaded or flanged.
2) NPS 2-1/2 and Larger: Flanged.

4. Manufacturers:

a. Invensys Energy Metering.
b. American Meter Co.
c. Or equal.

5. Small-Capacity Gas Meters: ANSI B109.1, diaphragm type, with registration in cubic feet for meters with capacities of 500 cfh and less.

6. Large-Capacity Gas Meters: ANSI B109.2, diaphragm type, with registration in cubic feet for meters with capacities of more than 500 cfh, but less than or equal to 1,000 cfh.
7. Rotary Gas Meters: ANSI B109.3, rotating-lobe type, with registration in cubic feet for meters with capacities of more than 1,000 cfh.
8. Gas Meter Bars: (For meters 1" and larger) Malleable-or cast-iron frame for supporting Recharge meter. Include offset swivel pipes, nuts with O-ring seal, field-installed dielectric device, and threaded ends.
9. Exception: Omit offset swivel pipes if dimensions match meter connections.
10. Manufacturers:

    a. Fisher Controls International
    b. McDonald, A.Y. Mfg. Co.
    c. Mueller Company.
    d. National Meter.
    e. Schlumberger Limited.
    f. Or equal.

11. Volume Correctors: Pulse output flow computer for temperature and pressure volumetric correction of natural gas.

    a. Power Requirements: 24 volts DC power, provided by building management system controls contractor.
    b. Instrument Enclosure: Rugged cast aluminum casing.
    c. Mounting: Directly on gas meter.
    d. Transducers: Integral pressure and temperature transducers.
    e. Corrected Volume Totalizer: Local indexing in cubic feet.
    f. Hazardous Rating: Class 1, Div. 1, Group D per NEC
    g. Outputs:

        1) Corrected indexing, non-re-settable.
        2) Pulse transmitter for remote billing purposes.
        3) 4-20 ma output, for flow recording and analysis.

    h. Accuracy: 1% accuracy.
    i. Approvals: UL Listed.

12. Manufacturers:

    a. Equimeter.
    b. Mercury.
    c. American Meter Co.
    d. Invensys.
    e. National Meter Ind. Inc.
    f. Or equal.

2.8 PRESSURE REGULATORS

A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion resistant components, elevation compensator, and atmospheric vent.

1. Manufacturers:

a. Service Pressure Regulators:

1) American Meter Company.
2) Fisher Controls International, Inc.; Division of Emerson.
3) Invensys.
4) National Meter Industries, Inc.
5) Schlumberger Limited; Gas Div. 6) Or equal.

b. Line Pressure Regulators:

1) American Meter Company.
2) Donkin, Bryan RMG Canada, Ltd.
3) Fisher Controls International, Inc.; Division of Emerson.
4) Invensys.
5) Maxitrol Company.
6) National Meter Industries, Inc.
7) Schlumberger Limited; Gas Div.
8) Or equal.

2. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
3. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
4. Service Pressure Regulators: ANSI Z21.80. Include 100-psig- minimum inlet pressure rating.

5. Line Pressure Regulators: ANSI Z21.80 with 10-psig inlet pressure rating, unless otherwise indicated.

B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping. Normally vented outside with insect screen and U-turn end.

2.9 LABORATORY SAFETY DEVICE SYSTEM

A. Products in this section: All Products and Devices for a complete Laboratory Safety Device System shall be provided as shown on the Drawings and as listed in the Equipment Schedule of the Section.

1. Utility Controller: At each science classroom and elsewhere as shown on Drawings, provide a Utility Controller with fascia panel mounted switches to activate remote solenoid to control natural gas. Utility Controller shall comply and be certified to Underwriter's

Laboratory UL61010-1 3rd Edition Standards. Utility Controller shall have integrated printed circuit board and microprocessor with adaptable programming features. Utility Controller shall provide line voltage signal for output circuit, to be transformed down to 24 VDC, and shall provide inputs for remote emergency operator and BMS. The Utility Controller shall be equipped with an Authority Key Lock that restricts activation of output signal to the instructor or educator. Utility Controller shall be provided with a fascia mounted Emergency Shut Off Button. Output signal will require Key Lock Authority for reset.

2. Solenoid Valve: At each science classroom as shown on Drawings, provide UL-approved solenoid for gas service. Solenoids shall be normally closed and fail closed on loss of power. Number of solenoids, intended use and pipe sizes are as noted in Equipment Schedule or Drawings.
3. Remote Shut Off Button: Where shown on Drawings and where classroom size and configuration restricts clear path from work areas to Utility Controller, provide a wall mounted Shut Off Button. Assembly shall be located as shown on Drawings and as stipulated in Equipment Schedule. Integrate assembly with low voltage input on Utility Controller.
4. Provide a manufacturer's parts warranty covering 36 months from date of product shipment
5. Manufacturers:

    a. American Gas Safety LLC, Merlin 1000Si
    b. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for fuel oil piping system to verify actual locations of piping connections before equipment installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off fuel gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.

3.3 RE-CHARGE METER ASSEMBLY INSTALLATION

A. Install re-charge meter assemblies inside in a mechanical room or if approved by University's Representative aboveground, outside building

1. Set outside meter assembly on, or supported over, precast concrete bases. Excavate earth and make level beds to support bases. Set bases level with top surface projecting 3 inches

above finished grade. Concrete bases are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

B. Include gas valve or plug valve, strainer, earthquake valve pressure regulator, and meter for each assembly.

C. Install gas valve or plug valve and strainer upstream from each pressure regulator.

D. Install outside pressure regulators with vent outlet turned down and with corrosion-resistant metal insect screen.

E. Inside pressure regulator shall have vent outlet extended to outside and turned down and protected with insect screen.

F. Select locations of gages from options in first paragraph below or delete if not required.

G. Install pressure gage tap upstream and downstream from each pressure regulator.

H. Install meters downstream from pressure regulators, unless noted otherwise.

1. Meters with connections NPS 1 and smaller on meter bars.
2. Meters with connections larger than NPS 1 supported from piping or set on concrete bases.

I. Provide adequate points of connections to install a temporary by pass around the meter, so that the meter can be removed and replaced without interrupting gas service to the facility.

3.4 LABORATORY SAFETY DEVICE SYSTEM

A. Integration and Configuration:

1. Building Automation/ Management System (BMS): Where shown on Drawings, provide low voltage integration wiring from each Utility Controller to connection point on BMS. Configure Utility Controller to comply with BMS requirements. Utility Controller can accept low voltage signal from Fire Alarm to shutdown utilities in case of fire alarm. Final connection by others.
2. System Configuration: Utility Controllers shall be factory configured to the standard configurations and shall be capable of field adjustments to meet specific project modification requirements. Configurations are limited to DIP switch adjustments on rear of fascia panel without the requirement of additional equipment.
3. Panel Details:

a. Classroom Gas: Gas at student work-stations shall be controlled by independent output circuit at the Utility Controller. Gas shall be activated by Utility Controller fascia panel switches and the engaging of the authority control key. Activation of gas shall be restricted to the instructor by means of the authority key lock switch.

b. Time Out Function: Each Utility Controller be pre-set to shut down after either 2 hours, 4 hours, 8 hours, or have this function disabled. This configuration shall be adjusted via DIP switches in the Utility Controller.
c. Building Automation or Management System: Where indicated by the Drawings, configure each Utility Controller to integrate with the BMS. The BMS shall monitor the Utility Controller for Gas "ON" or Emergency Shut Off activation. Utility Controller shall accept fire alarm signal from BMS for automatic shutdown. The output signal from the Utility Controller shall be in the form of a NO or NC low voltage relay output signal.
d. Emergency Shut Off Re-Set: Unless stated elsewhere on Drawings, The Utility Controller shall only re-set from Emergency Shut Off after engagement of the authority key on fascia panel and after local Emergency Shut Off has been reset.
e. Fire Alarm Re-Set: Unless stated elsewhere on Drawings, the Utility Controller shall be configured so that continued fire alarm signal to Utility Controller shall prevent reset.
f. Emergency Gas Shut Off: Each Utility Controller shall be configured so that pressing Emergency Shut Off will disable gas.

B. System Execution:

1. Installation:

a. Install in accordance with manufacturer's recommendations and instructions. Verify manufacturer's mounting heights to comply with ADA or other standards.
b. Finish and install all devices as shown in Drawings and as specified herein. Where device is to be installed by other trades, furnish and then turn over to appropriate trade for installation.
c. Furnish, install and make final connections to monitoring and remote Emergency Shut Off Buttons as indicated on Drawings and specified herein. Furnish and install low voltage and volt-free control wiring from Utility Controller to connection point on BMS.

2. Plumbing: Make final connections to gas piping system where indicated by Drawings and specifications. Install in accordance with Division 22 specification sections and as described here within this section.
3. Electrical: Electrical Contractor shall furnish all conduit and wiring, making final wiring connections to all equipment as indicated by Drawings and specifications. Contractor shall be responsible for all system configurations, integration, test and start-up.

C. System Test and Start-up:

1. Prior to placing the Utility Controller System into service, perform all Start-Up procedures and checklists as stated in Manufacturer's Operations and Maintenance Procedure.
2. Verify that all components and devices comply with manufacturer's requirements and recommendations and that all devices and installations conform to Drawings and specification requirements.

3. Upon completion of all Start-Up tests, place the system into service. Complete all warranty registration documents. Submit originals with other project related closeout and O & M documentation. Review all operating procedures with a representative of the owner. Provide all System Authority Keys to the owner's representative.

3.5 SERVICE ENTRANCE PIPING

A. Extend fuel gas piping and connect to Campus fuel gas distribution for service entrance to building.

B. Provide exterior fuel gas distribution system piping, earthquake valve, pressure regulator, and meter.

C. Install dielectric fitting downstream from and adjacent to each meter unless meter is supported from meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Dielectric fittings are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

D. Install strainer upstream from each earthquake valve. Strainers are specified in Division 22 Section 22 1119 "Domestic Water Piping Specialties."

3.6 PIPING APPLICATIONS

A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.

B. Fuel Gas Piping, 5 psig or Less:

1. NPS 1/2 to NPS 2: Steel pipe, malleable-iron threaded fittings, and threaded joints.
2. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints.

C. Underground Fuel Gas Piping: Do not install pipe under building floor slabs. Steel pipe, steel welding fittings, and welded joints. Encase in containment conduit.

D. Underground-to-Aboveground Piping Connections: Service-line riser.

E. PE-to-Steel Piping Connections: Transition fitting.

3.7 VALVE APPLICATIONS

A. Appliance Shutoff Valves for Pressure 0.5 psig or Less: Appliance connector valve or gas stop.

B. Appliance Shutoff Valves for Pressure 0.5 to 5 psig: Gas valve.

C. Piping Line Solenoid Valves for Pressure 0.5 to 5 psig: Gas valve.

D. Piping Line Valves, NPS 2 and Smaller: Gas valve.

E. Piping Line Valves, NPS 2-1/2 and Larger: Plug valve or general-duty valve.

F. Valves at Meter, NPS 2 and Smaller: Gas valve.

G. Valves at Meter, NPS 2-1/2 and Larger: Plug valve.

3.8 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

B. Concealed Locations:

C. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of University's Representative, whether or not such spaces are used as plenums.

1. In Floor Channels: Gas piping may be installed in floor channels, subject to approval of University's Representative. Channels must have cover and be open to space above cover for ventilation.
2. In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside stud partitions or hollow walls.

a. Exception: Pipe passing through partitions or walls.

3. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts. Do not install gas piping in floors, under building floor slabs on grade or solid walls.

a. Exception: Accessible above-ceiling space specified above.

D. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of meters. Locate where readily accessible for cleaning and emptying.

1. Construct drips and sediment traps using tee fitting with bottom outlet and stop valve. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap and opening of the valve.

E. Conceal pipe installations in hollow walls, pipe spaces, utility spaces, above ceilings, below exterior grade floors, and in floor channels, unless indicated to be exposed to view.

G. Install pressure test ports, upstream and downstream of gas meter.

H. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

I. Connect branch piping from top or side of horizontal piping.

J. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

K. Install pipe bollards or other suitable barriers in front of outside gas meter assemblies for protection.

L. Install strainer on inlet of each line pressure regulator.

M. Install pressure gage taps upstream and downstream from each line pressure regulator.

N. Install flanges on valves, specialties, and equipment having NPS 2-1/2 and larger connections. Install unions similarly on NPS 2" and smaller.

O. Install vent piping for gas pressure regulators and gas trains, extend up through roof, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion resistant insect screens in large end.

3.9 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 22 Section 22 0500 "Common Work Results for Plumbing" and 22 1613 "Facility Natural Gas Piping."

B. Use materials suitable for fuel gas.

C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.10 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 22 Section 22 0529 "Hangers and Supports for Plumbing."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes: CPC is more stringent for smaller sizes.

C. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.

D. NPS 3/4 and 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.

E. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.

F. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

G. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

H. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.11 CONNECTIONS

A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.

B. Install piping adjacent to appliances to allow service and maintenance.

C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

E. Retain two paragraphs and associated subparagraph below for electrically operated devices.

F. Ground equipment according to Division 26 Section 26 0526 "Grounding and Bonding for Electrical Systems."

G. Do not use gas pipe as grounding electrode.

H. Connect wiring according to Division 26 Section 26 0519 "Low Voltage Electrical Power Conductors and Cables."

3.12 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each meter, pressure regulator, and specialty valve.

1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
2. Nameplates, pipe identification, and signs are specified in Division 22 Section 22 0553 "Identification for Plumbing."

3.13 PAINTING

A. Use materials and procedures in Division 09 painting Sections.

B. Paint exterior meters, pressure regulators, and specialty valves.

1. Color: Gray or as directed by University's Representative.

3.14 FIELD QUALITY CONTROL

A. Test, inspect, and purge piping according to CPC and requirements of University's Representative.

B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

C. Verify capacities and pressure ratings of re-charge meters, pressure regulators, valves, and specialties.

D. Verify correct pressure settings for pressure regulators.

E. Verify that specified piping tests are complete.

3.15 COORDINATION

A. Coordinate gas -meter power and control wiring connections, and interface with Controls Contractor. Prior to procurement, ensure metering assembly shall have output compatible with the Building Management System for both volumetric indexing (pulse signal), and instantaneous flow rate (4-20ma signal).

B. Coordinate gas -meter and transmitter body space requirements with other trades.

C. Coordinate location and installation of gas -meter protective barriers with other trades.

D. Coordinate gas -meter label numbering with Controls Contractor for proper graphical interface and tenant billing information.

END OF SECTION 22 1616

SECTION 22 3300 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following electric water heaters:
   1. Instantaneous electric water heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, furnished specialties, and accessories.

B. LEED Submittal:

   1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Warranty: Special warranty specified in this Section.

1.4 INFORMATIONAL SUBMITTALS

A. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

B. Source quality-control reports.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty operation of controls.
   b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

   a. Instantaneous Electric Water Heaters: Minimum one year parts and labor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to Water Heater Schedule on the drawings for additional information on the capacity and characteristics of each heater.

2.2 INSTANTANEOUS ELECTRIC WATER HEATERS

A. Instantaneous Electric Water Heaters: UL listed for tankless electric (water heater) heating appliance.

1. Available Manufacturers:

   a. Eemax, Inc.
   b. Chronomite Laboratories, Inc.
   c. Stiebel Eltron
   d. Or equal.

2. Construction: Element shall be iron free, Nickel Chrome material, or copper piping or tubing complying with materials for potable water, without storage capacity.

   a. Pressure Rating: 150 psig.
   b. Heating Element: Resistance heating system.
   c. Temperature Control: microprocessor temperature control, integrated mixing valve.
   d. Safety Control: High-temperature-limit cutoff device or system.

e. Jacket: Aluminum or steel with enameled finish or plastic.
f. Heater shall be fitted with 1/2" pipe compression nuts (5/8" OD) or 3/8" sleeves, to eliminate need for soldering

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters level and plumb, according to construction documents, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater.

C. Include a shutoff valve and thermometer in each water heater's inlet and outlet piping.

D. Ground equipment according to Division 26 Section 26 0256 "Grounding and Bonding for Electrical Systems."

3.2 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain electric water heaters. Refer to Division 01 Section 01 7900"Demonstration and Training."

END OF SECTION 223300

SECTION 22 3500 - DOMESTIC WATER HEAT EXCHANGERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following heat exchangers:
   1. Instantaneous heat exchangers.
   2. Expansion tanks.
   3. Heat-exchanger accessories.

1.3 SUBMITTALS

A. Product Data: For each type and size of heat exchanger indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Seismic Qualification: Manufacturer's certification of seismic qualification according to ASCE 7-05. Submit ASCE 7-05 special seismic certification as required. Include method used to determine compliance with requirements.

   1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of heat exchangers through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of heat exchangers and are based on the specific system indicated. Refer to Division 01 Section 01 6000 "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with water.

1. All plumbing components, including but not limited to piping, valves, backflow preventers, fixtures, etc. that are connected to the domestic water system which convey water to be used for human consumption shall meet the NSF-372, 'Lead-Free' requirements. Items not intended to dispense water for human consumption such as flush valves, tub fills, shower valves, or piping accessories connected to non-potable water systems, are not required to meet the 'Lead Free' requirements.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of heat exchangers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including heat exchanger, and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Instantaneous Heat Exchangers:

1) Tube Coil and Shell: One year.
2) Controls and Other Components: One year.

PART 2 - PRODUCTS

2.1 INSTANTANEOUS HEAT EXCHANGERS

A. Manufacturers:
1. AERCO International, Inc.
2. Cemline Corporation.
3. Patterson-Kelley.
4. PVI Industries, LLC.

B. Description: Tube coil and shell, packaged assembly of heat-exchanger coil, controls, and specialties for heating domestic water.

C. Construction: ASME-code, negligible-capacity, copper-lined, carbon-steel or copper-alloy shell.
1. Configuration: Horizontal or Vertical.
2. Shell Tappings: Factory fabricated of materials compatible with water heater shell. Attach tapping's to shell before testing and labeling.
a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
3. Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire shell and nozzle except connections and controls.
4. Heat-Exchanger Coil: Copper, double-wall.

D. Temperature Control: Adjustable thermostat that operates [team control valve and that is capable of maintaining outlet-water temperature within 5 deg F of setting.

E. Safety Control: Automatic, high-temperature-limit cutoff device or system.

F. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into shell.

G. Miscellaneous Components for Heating Hot-Water Unit: Control valve, valves, and piping. Include components fitted for electronic control.

H. Miscellaneous Components for Steam Unit: Strainers, steam-control valve, steam trap, valves, pressure gage, thermometer, and piping. Include components fitted for electronic control.

I. Stand: Factory fabricated for floor mounting.

2.2 EXPANSION TANKS

A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.

1. Manufacturers:

a. AMTROL Inc.
b. Smith, A. O.; Aqua-Air Div.
c. State Industries, Inc.
d. Watts Regulator Co.

2. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

3. Refer to the drawings for capacities and characteristics.

2.3 HEAT-EXCHANGER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect heat-exchanger storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test heat-exchanger storage tanks before shipment to minimum of one and one-half times pressure rating.

PART 3 - EXECUTION

3.1 HEAT-EXCHANGER INSTALLATION

A. Install heat exchangers on concrete bases. Concrete bases are specified in Division 22 section 22 0500 ”Common Work Results for Plumbing.”

B. Install heat exchangers level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Anchor heat exchangers to substrate.

D. Comply with mounting and anchoring requirements for seismic installations.

E. Install combination temperature and pressure relief valves in water piping for heat exchangers without storage. Extend relief-valve outlet, with drain piping same as water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install heat-exchanger drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for heat exchangers that do not have tank drains. Refer to Division 22 Section 22 1119 "Domestic Water Piping Specialties" for hose-end drain valves.

G. Install thermometer on each heat-exchanger domestic-water inlet and outlet piping, and install thermometer on each heat-exchanger heating-fluid inlet and outlet piping. Refer to Division 22 Section 22 0519 "Meters and Gages for Plumbing Piping" for thermometers.

H. Install pressure gages on heat-exchanger heating-fluid piping. Refer to Division 22 Section 22 0519 "Meters and Gages for Plumbing Piping" for pressure gages.

I. Fill heat exchangers with water.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to heat exchangers to allow service and maintenance. Arrange piping for easy removal of heat exchangers.

C. Ground equipment according to Division 26 Section 26 0526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace heat exchangers that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers. Refer to Division 01 Section 01 7900 "Demonstration and Training."

END OF SECTION 223500

SECTION 22 4000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes plumbing fixtures and related components.

B. Related Sections include the following:

1. Division 22 Section "Emergency Plumbing Fixtures."
2. Division 22 Section "Drinking Fountains."
3. Division 22 Section “Domestic Water Piping Specialties" for backflow preventers and specialty fixtures not in this Section.

1.2 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.3 SUBMITTALS

A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 01.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70) Article 100, by a testing agency acceptable to University’s Representative, and marked for intended use.

C. Regulatory Requirements: Comply with requirements of California Building Code about accessible plumbing fixtures for people with disabilities. See architectural floor plans for accessible fixture requirements.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. Regulatory Requirements: Comply with California Energy Commission Title-24 water conservation and consumption rates for plumbing fixtures.

F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Hand Sinks: NSF 2 construction.
3. Slip-Resistant Bathing Surfaces: ASTM F 462. Applicable, Shower pans.
4. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
5. Vitreous-China Fixtures: ASME A112.19.2M.

I. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Faucets: ASME A112.18.1M.
2. Hose-Connection Vacuum Breakers: ASSE 1011.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
5. NSF Materials: NSF 61.
6. Pipe Threads: ASME B1.20.1.
7. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
8. Supply and Drain Fittings: ASME A112.18.1M.

J. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1M.
4. Hand-Held Showers: ASSE 1014.
5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Pipe Threads: ASME B1.20.1.

8. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
10. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

K. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1M.
3. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
4. Tubular Brass Drainage Fittings and Piping: ASME A112.18.2M.

L. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430. Applicable.
2. Floor Drains: ASME A112.6.3.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 LAVATORY FAUCETS (See Fixture Schedule)

2.3 SHOWER FAUCETS (See Fixture Schedule)

2.4 SINK FAUCETS (See Fixture Schedule)

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Guard: Manufactured, plastic covering for hot-water supplies and trap and drain piping and complying with ADA requirements.

1. Manufacturers:

a. Plumberex Specialty Products, "Pro-Extreme."
b. True Bro "Lav Guard 2."
c. Or equal.

2.6 FIXTURE SUPPORTS

A. Water-Closet Support: Water-closet combination carrier designed for accessible or standard mounting height. Include left-hand or right-hand, single or double, vertical or horizontal, hub and-spigot or hub-less waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

B. Urinal Support: Type II, urinal carrier with hanger and bearing plates. Include coated rectangular steel uprights with feet.

C. Lavatory Support: Type II, lavatory carrier with concealed arms and tie rod. Include steel uprights with feet.

D. Sink Support: Type II, sink carrier with hanger plate, bearing studs, and tie rod. Include steel uprights with feet.

E. Manufacturers:

1. Watts Drainage Products USA.
2. Jay R. Smith.
3. Josam.
4. Zurn.
5. Or equal.

2.8 SHOWER RECEPTORS (See Fixture Schedule)

2.9 DISPOSERS

A. Disposer: Batch-feed, household, food-waste disposer. Include 115-V ac, 1725-rpm, 1/2 -hp motor with overload protection and reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.

1. Manufacturers:

a. Insinkerator, Badger 5.

b. Waste King
c. Or equal.

2. Model: Sound-insulated chamber and stainless-steel outer shell.

2.10 WATER CLOSETS (See Fixture Schedule)

A. Toilet Seat: Solid plastic, Self-Sustaining Check Hinge, open front.

1. Manufacturers:

a. Olsonite: 10SSC.
b. Or equal.

B. Fixture Support: Water-closet support combination carrier. Manufactured waste fitting with seal and chrome plated fixture bolts.

2.11URINALS (See Fixture Schedule)

2.12 LAVATORIES (See Fixture Schedule)

2.13 KITCHEN SINKS (See Fixture Schedule)

2.14 SERVICE SINKS (See Fixture Schedule)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings, and other components per manufacturers' written instructions.

B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-hanging fixtures with tubular waste piping attached to supports.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
   1. Exception: Use ball valve if stops are not specified with fixture.

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install toilet seats on water closets.

M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

O. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install shower, flow-control fittings with specified maximum flow rates in shower arms.

Q. Install traps on fixture outlets.

   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

R. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

S. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Common Work Results for Plumbing" for escutcheons.

T. Set service basins in leveling bed of cement grout. Refer to Division 22 Section "Common Work Results for Plumbing" for grout.

U. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 07 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

F. Ground Equipment: Scope of work provided under another division. Tighten electrical connectors and terminals per manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers, and controls. Replace damaged and malfunctioning units and controls. .

C. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by University's Representative.

END OF SECTION 22 4000

SECTION 22 4500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following emergency plumbing fixtures:

1. Combination units.

B. Related Sections include the following:

1. Division 22 Section "Plumbing Fixtures".
2. Division 22 Section "Sanitary Waste Piping Specialties" for floor drains.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm, ambient temperature water.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings: Submit for the fixture.

C. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water. Equivalent certification of compliance to NSF by an ANSI accredited third-party certification body such as Intertek ETL is acceptable.

PART 2 - PRODUCTS

2.3 COMBINATION UNITS (See Fixture Schedule)

A.:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bradley Corporation.
    b. Guardian Equipment Co.
    c. Haws Corporation.
    d. Lab Safety Supply Inc.
    e. WaterSaver Faucet Co.
    f. Western Emergency Equipment.
    g. Or Equal**.**

2.4 SOURCE QUALITY CONTROL

A. Certify performance of plumbed emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.

G. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

H. Install equipment nameplates or equipment markers on fixtures and equipment signs on water tempering equipment. Identification materials are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water tempering equipment.

C. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.

3.4 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

C. Report test results in writing.

3.5 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 22 4500

SECTION 22 4700 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Drinking fountains with bottle filler.
2. Fixture supports.

1.2 DEFINITIONS

A. Accessible Drinking Fountains: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain unless one is specifically indicated.

1.3 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Equipment cuts.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements of CBC, Chapter 11B.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 DRINKING FOUNTAINS

A. Drinking Fountains: Refer to Plumbing Fixture Schedule.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay Manufacturing Co.
b. Haws Corporation.
c. Oasis Corporation.
d. Sunroc Corp.
e. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use mounting frames for recessed drinking fountains, unless otherwise indicated.

B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed drinking fountains to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by University's Representative.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section 22 1116 "Domestic Water Piping and Valves."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section 22 0500 "Common Work Results for Plumbing."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section 07 9200 "Joint Sealants."

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.5 FIELD QUALITY CONTROL

A. Drinking Fountain and Bottle Filler Testing: After fixture has been installed, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.7 CLEANING

A. Removal of paint splatters and other spots, dirt, and debris, cleaning of fixtures provided by another division scope of work.

END OF SECTION 22 4700

SECTION 22 6000 - CHEMICAL-WASTE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following components for chemical-waste piping:

1. Single-wall piping.
2. Special-duty valves.
3. Piping specialties.

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. PE: Polyethylene plastic.

C. PP: Polypropylene plastic.

D. PTFE: Polytetrafluoroethylene plastic.

E. PVC: Polyvinyl chloride plastic.

F. PVDF: Polyvinylidene fluoride plastic.

G. TFE: Tetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow Drainage Piping:

1. Single-Wall Piping Pressure Rating: 10 feet head of water.

B. Force-Main Piping:

1. Single-Wall Piping Pressure Rating: At least equal to system operating pressure but not less than 100 psig.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting seismic restraints for above ground piping.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For chemical-waste specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain pipe, fittings, and joining materials for each piping system through one source from a single manufacturer.

1. Exception: Piping from different manufacturers may be used in same system if indicated and suitable transition fittings matching both piping materials are used. University's Representative approval shall be received prior to use.

B. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to University's Representative, and marked for intended use.

D. NFPA Compliance: Comply with NFPA 70, "National Electrical Code."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.

B. Do not store plastic pipe or fittings in direct sunlight.

C. Protect pipe, fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:

1. Notify University's Representative no fewer than fourteen days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without University's Representative's written permission.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term “or equal”, comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before the use of an unnamed manufacturer or product.

2.2 SINGLE-WALL PIPE AND FITTINGS

A. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with fusion -joint ends. 180°F resistance to continuous heat.

1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. IPEX Inc.
    b. Orion Fittings, Inc.
    c. Town & Country Plastics, Inc.
    d. Watts Industries (Canada) Inc.
    e. Zurn Plumbing Products Group; Chemical Drainage Systems.
    f. Or equal.

B. PP Pressure Pipe and Fittings: Pipe extruded and fittings molded from PP resin complying with ASTM D 4101; with SDR 11 or Schedule 80 dimensions and socket or butt-fusion fittings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Asahi/America.
    b. Fischer, George, Inc.
    c. Flo Safe, Inc.
    d. NIBCO INC.; Chemtrol Div.
    e. Town & Country Plastics, Inc.
    f. Orion.
    g. Or equal.

C. PVDF Drainage Pipe and Fittings: Pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PVDF resin complying with ASTM D 3222; with drainage pattern fittings complying with ASTM D 3311 except with fusion -joint ends. 285°F resistance to continuous heat.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Orion Fittings, Inc.
b. Watts Industries (Canada) Inc.
c. Zurn Plumbing Products Group; Chemical Drainage Systems.
d. Town & Country Plastics
e. Ipex, Inc.
f. Or equal.

D. PVDF Pressure Pipe and Fittings: Pipe extruded and fittings molded, with Schedule 80 dimensions, from PVDF resin complying with ASTM D 3222; with fusion-joint ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fischer, George, Inc.
b. Flo Safe, Inc.
c. NIBCO INC.; Chemtrol Div.
d. Orion Fittings, Inc.Or equal.

E. High-Silicon-Iron, Mechanical-Joint Pipe and Fittings: ASTM A 861, pipe and drainagepattern fittings; and stainless-steel clamps with TFE inner sleeve and CR outer sleeve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flowserve Corporation; Foundry Operations.
b. Duriron, Inc.
c. Or equal.

2.3 JOINING MATERIALS

A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

B. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.

C. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.

D. Flanges: Assemblies of companion flanges and gasket complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

2.4 SPECIAL-DUTY VALVES

A. PP and PVDF Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Asahi/America.
c. Fischer, George, Inc.
d. IPEX Inc.
e. NIBCO INC.; Chemtrol Div.
f. Plast-O-Matic Valves, Inc.
g. Sloane, George Fischer, Inc.
h. Spears Manufacturing Co.
i. Town & Country Plastics, Inc.
j. Or equal.

2. Standard: MSS SP-122; same material as piping.
3. Pressure Rating: minimum 150 psig at 73 deg F.
4. End Connections: Threaded, union ends.

B. Plastic Valves Other Than Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Asahi/America.
c. Colonial Engineering, Inc.
d. Fischer, George, Inc.
e. Hayward Industrial Products, Inc.
f. ITT Industries; Engineered Valves.
g. NIBCO INC.; Chemtrol Div.
h. Plast-O-Matic Valves, Inc.
i. Spears Manufacturing Co.
j. Thermoplastic Valves, Inc.
k. Town & Country Plastics, Inc.
l. Or equal.

2. Type: check, gate, or globe types; same material as or compatible with piping.
3. Pressure Rating: minimum 150 psig at 73 deg F.

2.5 PIPING SPECIALTIES

A. Plastic Dilution Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. IPEX Inc.
    b. Orion Fittings, Inc.
    c. Sloane, George Fischer, Inc.
    d. Town & Country Plastics, Inc.
    e. Or equal.

2. Material: Corrosion-resistant PP, with removable base.
3. End Connections: Mechanical joint.
4. Dilution Tanks: 1-gal. capacity, with clear base unless colored base is indicated; with two NPS 1-1/2 top inlets and one NPS 1-1/2 side outlet.

E. High-Silicon-Iron Floor Drains: Refer to Plumbing Fixture Schedule

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flowserve Corporation; Foundry Operations.
    b. Durion, Inc.
    c. Or equal.

G. PP Floor Drains: Refer to Plumbing Fixture Schedule

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. IPEX Inc.
    b. Orion Fittings, Inc.
    c. Schier Products Company.
    d. Sloane, George Fischer, Inc.
    e. Town & Country Plastics, Inc.
    f. Watts Industries (Canada) Inc.
    g. Or equal.

H. PP and PVDF Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Orion
    b. Enfield
    c. GF Fuseal
    d. Or equal.

K. Plastic Backwater Valves:

1. Description: Full-port NPS 3 check valve, PP or PVDF, matching or compatible with system piping and compatible with system liquid, with EPDM seals and flanged ends.
2. Standard: ASTM A 861, high-silicon iron, NPS 1-1/2, with clamping device and 4-, 6-, or 8-inch- high overflow fitting, as indicated.

M. PP Sink Outlets:

1. Description: NPS 1-1/2, with clamping device, stopper, and 7-inch- high overflow fitting.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 CONCRETE BASES

A. Anchor Equipment to concrete bases. Concrete scope of work by others. Refer to Division 3.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground Chemical-Waste Piping: Use any of the following piping materials for each size range:

1. NPS 1-1/2 to NPS 6: PP drainage piping and electrofusion joints.
2. NPS 1-1/2 to NPS 6: PVDF drainage piping and electrofusion joints.

D. Under Slab-on-Grade, Chemical-Waste Piping: Use any of the following piping materials for each size range:

1. NPS 1-1/2 to NPS 6: PP drainage piping and electrofusion joints.
2. NPS 1-1/2 to NPS 6: PVDF drainage piping and electrofusion joints.
3. NPS 1-1/2 to NPS 6: NPS 2 to NPS 4 high-silicon-iron piping with bell-and-spigot ends and calked joints.

E. Above ground, Chemical-Waste, Force-Main Piping: Use any of the following piping materials for each size range:

1. NPS 2 to NPS 4: PP pressure pipe, SDR 11, with butt-fusion fittings and heat-fusion joints.
2. NPS 2 to NPS 4: PP pressure pipe, flame-retardant, Schedule 80, and fusion fittings and heat-fusion joints.
3. NPS 2 to NPS 4: PVDF pressure piping, and socket fittings, flame-retardant and heat fusion joints.

3.4 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. If specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Ball, or gate valves.
2. Throttling Duty: Ball, or globe valves.
3. Butterfly valve shall not be used.

B. Plastic valves; with wetted surfaces same material as or compatible with piping and system liquid. PVC or CPVC valves shall not be used.

3.5 PIPING INSTALLATION

A. Refer to Division 22 Section "Basic Work Results for Plumbing" for basic piping installation.

B. Install piping next to equipment, accessories, and specialties to allow service and maintenance.

C. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

D. Flanges may be used on aboveground piping, unless otherwise indicated.

E. Install drain valves at low points in chemical-waste force mains.

F. Provide insulation with 1-hour fire rating to all polypropylene (PP & PVDF) piping installed above floor in fire resistive construction as required by NFPA, CBC and Campus Fire Marshal.

3.7 PIPING SPECIALTY INSTALLATION

A. Install piping specialties as components of connected chemical-waste piping system.

3.8 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Basic Work Results for Plumbing" for basic piping joint construction. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.

C. Plastic-Piping, Heat-Fusion Joints: Make polyolefin pressure-piping joints according to ASTM D 2657.

D. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.

3.9 HANGER AND SUPPORT INSTALLATION

A. Pipe sizes in this Article refer to aboveground, single-wall piping and carrier piping of containment piping.

B. Refer to Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

C. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or MSS Type 42, riser clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

D. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

F. Support vertical piping and tubing at base and at each floor.

G. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch.

H. Install vinyl-coated hangers for PP piping .in accordance with CPC requirements.

I. Install supports for vertical PP piping in accordance with CPC requirements.

J. Install vinyl-coated hangers for PVDF piping in accordance with CPC requirements.

K. Install supports for vertical PVDF piping.

L Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grounding of equipment under another section of work. Refer to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connecting of wiring under another section of work. Refer to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

3.11 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.13 CLEANING

A. Use procedures described below:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Clean piping by flushing with potable water.

END OF SECTION 22 6000

SECTION 22 6213 - VACUUM PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes laboratory vacuum piping and related specialties.

B. Related Sections include the following:

1. Division 11 Section "Laboratory Fume Hoods" for laboratory fume hood outlets requiring laboratory vacuum service.
2. Division 12 Section "Laboratory Casework" for wood casework and outlets requiring laboratory vacuum service.
3. Division 22 Section "Meters and Gages for Plumbing" for pressure gages.
4. Division 22 Section "Vacuum Equipment for Laboratory Facilities" for laboratory vacuum equipment and related accessories.

1.2 DEFINITIONS

A. PTFE: Polytetrafluoroethylene plastic.

B. TFE: Tetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide laboratory vacuum piping systems that comply with NFPA 99, Category 4 requirements for materials and installation.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Laboratory vacuum tubes and fittings.
2. Flexible pipe connectors.

B. Coordination Drawings: For laboratory vacuum systems. Include relationship to other services that serve same work area.

C. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

D. Piping Material Certification: Signed by Installer certifying that laboratory vacuum piping materials comply with NFPA 99 requirements.

E. Qualification Data: For testing agency.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

B. Comply with NFPA 99, "Health Care Facilities," for materials and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 TUBES AND FITTINGS

A. Copper Tube: ASTM B 88, Type L, seamless, hard drawn-temper, tube.

1. Fittings:

a. Copper Pressure Fittings: ASME B16.22, wrought-copper solder joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
b. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
c. Copper Unions: ASME B16.22 or MSS SP-123.
d. Mechanical Tees, nipples, reducing coupling. Street Elbows and bushings shall not be used on Campus.

B. Flexible Pipe Connectors: Corrugated-bronze inner tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
4. Manufacturers:

a. ANAMET Inc.
b. Flex-Hose Co., Inc.

c. Flexicraft Industries.
d. Hyspan Precision Products, Inc.
e. Mercer Rubber Co.
f. Metraflex, Inc.
g. Proco Products, Inc.
h. Unaflex Inc.
i. Or equal.

2.3 JOINING MATERIALS

A. Refer to Division 22 Section "Common Work results for Plumbing" for joining materials not in this Section.

B. Brazing Filler Metals: AWS A5.8, BCuP3 & BCuP4 series alloys. Flux is prohibited unless used with bronze fittings.

C. Threaded-Joint Tape: PTFE.

D. Gasket Material: ASME B16.21, nonmetallic, flat, asbestos free, and suitable for oxygen service.

2.4 VALVES

A. Copper-Alloy Ball Valves: MSS SP-110, 3-piece-body, full-port ball valve rated for 400-psig minimum working pressure; with stainless steel ball, PTFE or TFE seats, blowout-proof stem, threaded or solder-joint ends, and locking-type handle designed for quarter turn between opened and closed positions.

1. Manufacturers:

a. Conbraco Industries, Inc.; Apollo Div. # 77-140, 77-240.
b. Or equal. (no known equal).

B. AWWA, Cast-Iron Gate Valves 3” and Larger:

1. Manufacturers:

    a. American Cast Iron Pipe Co.; American Flow Control Div.
    b. Crane Co.; Crane Valve Group; Stockham Div.
    c. Grinnell Corporation; Mueller Co.; Water Products Div.
    d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
    e. McWane, Inc.; Kennedy Valve Div.
    f. McWane, Inc.; M&H Valve Company Division
    g. NIBCO INC.
    h. United States Pipe and Foundry Company.
    i. Or equal.

1. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

    a. Minimum Working Pressure: 200 psig.
    b. End Connections: Mechanical joint, or flanged.
    c. Interior and Exterior Coating: Complying with AWWA C550, epoxy.
    d. Or equal.

C. Check Valves: Straight-through-pattern, spring-loaded ball check valve; designed for 300-psig minimum working pressure.

D. Safety Valves: Bronze body with settings to match system requirements.

1. Vacuum Relief Valves: Specialty manufacturer's option.

2.5 TEST GAS

A. Description: Oil-free dry nitrogen complying with CGA P-9, for purging and testing of piping.

2.6 IDENTIFICATION

A. Refer to Division 22 Section "Identification for Plumbing" for identification of piping, valves, gages, alarms, and specialties.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Piping: When using hard drawn copper tubing in accordance with ASTM B819 (medical gas tubing) the following cleaning procedures shall apply. When using hard drawn copper

tubing in accordance with ASTM B88 (water tubing) cleaning procedures noted below shall not apply. Perform the following procedures:

1. Clean laboratory vacuum tubes and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
2. Wash laboratory vacuum piping and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.

    a. Scrub to ensure complete cleaning.
    b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING APPLICATIONS

A. General: Use tube, fittings, and joining methods for laboratory vacuum piping systems according to the following applications:

B. Joining of Dissimilar Metal Piping: Use dielectric fittings. Refer to Division 22Section “Common Work Results for Plumbing" for dielectric fitting types.

1. NPS 2 and Smaller: Use dielectric fittings.
2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
3. Dielectric unions shall not be used.

C. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.

D. Laboratory Vacuum Piping: Use copper tube, long sweep copper pressure fittings, and brazed joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used for laboratory vacuum piping. If specific valve types are not indicated, the following requirements apply:

1. Shutoff Valves NPS 3 and Smaller: Copper-alloy ball valve, full-port type.
2. Check Valves NPS 3 and Smaller: Bronze.

3.4 PIPING INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping installation.

B. Install vacuum gages according to Division 22 Section "Meters and Gages for Plumbing."

C. Install flexible pipe connector and isolation valve at each connection to laboratory vacuum equipment.

D. Purge laboratory vacuum piping, using oil-free dry nitrogen, after installing piping but before connecting to alarms and gages.

E. Install isolation valve as indicated on drawings.

3.5 VALVE INSTALLATION

A. Refer to Division 22 Section “Common Work Results for Plumbing "for basic piping and valve installation.

B. Install shutoff valve as indicated on drawings.

C. Install check valves to maintain correct direction of fluid flow to and from laboratory vacuum specialties and equipment.

D. Install vacuum relief valves where recommended by specialty manufacturers.

E. Provide double shutoff drain valves to allow blowdown without losing vacuum Where indicated on drawings .

3.6 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Brazed Joints: Use silver- or copper-phosphorus-composition filler metal and comply with CDA's "Copper Tube Handbook," Section VII, "Brazed Joints**."**

3.7 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 22 Section "Mechanical Vibration and Seismic Controls for Plumbing" for seismic-restraint devices.

B. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or 42 clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.

C. ...Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters in accordance with CPC and NFPA..

G. Install supports for vertical copper tubing in accordance with CPC and NFPA..

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to specialties and equipment to allow service and maintenance.

3.9 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for laboratory vacuum piping systems according to NFPA 99. Refer to Division 22 Section "Identification for Plumbing" for labeling and identification materials.

B. Captions and Color-Coding: Use the following or similar captions and color-coding for laboratory vacuum piping products as required by NFPA 99.

1. Laboratory Vacuum Piping: Black boxed letters on white-and-black checkerboard background.

3.10 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Laboratory Vacuum Piping Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped vacuum systems. Include the following:

   a. Blow Down: Clear piping before connecting service connections or inlets.
   b. Pressure Tests: Subject each piping section to test pressure of 15 psig for 24 hours. Verify that pressure drop does not exceed 5 psig. Repair leaks with new materials and retest systems.
   c. Cross-Connection Tests: Perform as part of laboratory air piping testing.
   d. Alarm Tests: Operate systems and verify proper warning indication of each laboratory vacuum system function
   e. Labeling: Verify correct labeling.

2. Test and adjust controls and safeties.

B. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

1. Inspections performed.
2. Procedures, materials, and gases used.
3. Test methods used.
4. Results of tests.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain laboratory vacuum alarm system. Refer to Division 01 Section "Closeout Procedures."

END OF SECTION 22 6213

SECTION 22 6219 - VACUUM EQUIPMENT FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged, oil-lubricated, rotary vane vacuum pumps.
2. Vacuum equipment alarm systems.
3. Computer interface cabinets.

B. Related Sections include the following:

1. Division 22 Section "Vacuum Piping" for vacuum piping, valves, and related specialties:

1.2 DEFINITIONS

A. Actual Air: Air delivered at vacuum producer inlet. Flow rate is air measured in expanded cfm.

B. Laboratory Vacuum Equipment: Equipment and accessories for laboratory facilities.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

D. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vacuum equipment mounting, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Vacuum equipment shall withstand the effects of earthquake motions determined according to SEI/ASCE 7, NFPA 99 and CBC for seismic zone 4.

C. Laboratory vacuum equipment shall comply with NFPA 99. Level 1 requirement for installation and testing.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Wiring Diagrams: For power, signal, and control wiring.

B. Delegated-Design Submittal: For vacuum-producing equipment mounting indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of supports.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

C. Qualification Data: For qualified Installer and testing agency.

D. Field quality-control reports.

E. Operation and Maintenance Data: For vacuum equipment to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Laboratory Vacuum System Equipment for Laboratory Facilities: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum equipment testing indicated, that is an NRTL, and that is acceptable to University Representative.

1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

E. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for vacuum systems.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term “or equal”, comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before the use of an unnamed manufacturer or product.

2.2 GENERAL REQUIREMENTS FOR PACKAGED VACUUM PUMPS

A. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty vacuum pumps and receivers.

B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
2. Motor Controllers: Full-voltage, combination-magnetic type with under-voltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
3. Control Voltage: 120-V ac or less, using integral control power transformer.
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
6. Automatic control switches to alternate lead-lag vacuum pumps for multiplex vacuum pumps.
7. Instrumentation: Include vacuum pump inlet and receiver vacuum gages, hour meter, vacuum pump discharge-air and coolant temperature gages, and control transformer.
8. Alarm Signal Device: For connection to alarm system to indicate when backup vacuum pump is operating.

C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; bearing appropriate code symbols.

1. Interior Finish: Corrosion-resistant coating.
2. Accessories: Include vacuum relief valve, vacuum gage, and drain valve.

D. Mounting Frame: Fabricate base and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.3 LUBRICATED ROTARY VANE VACUUM PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Healthcare Products, Inc., Garner Denver
2. Ingersoll-Rand; Air Solutions Group.
3. Quincy Inc.
4. Busch Inc.
5. Or equal.

B. Description: Packaged unit.

C. Vacuum Pumps: Oil lubricated, rotary vane, air cooled type.

1. Inlet filters.
2. Outlet silencers and oil-mist separators on discharge piping.
3. Oil filter and initial fill of synthetic oil.
4. Oil and smoke exhaust eliminators.
5. Anti-suck-back valves
6. Vibration isolators on each pump

D. Receiver: ASME, vertical type.

1. Manual drain valve
2. Sight and vacuum gages
3. Corrosion resistant interior lining
4. Prepiped with valves and by-pass

E. Capacities and Characteristics: Refer to equipment schedule on drawings.

F. Controls:

1. The control system provides automatic lead/lag sequencing and automatic alternation of all pumps in order to equalize the amount of usage among the available vacuum pumps. The control system shall include:

    a. PLC controller and a 6” color touch screen HMI (Human Machine Interface) panel which displays the operating status of the unit.
    b. UL508A listed control panel in a NEMA 12 enclosure. The panel door will include: the HMI touch screen, audible and visual alarms with an acknowledge button, and an HOA switch for each pump.
    c. Magnetic starters
    d. Vacuum transducer for process control
    e. Single point power connection
    f. Redundant 120Vac control transformers with fused primary and secondary protection.

g. System overload trip, high temperature conditions, low vacuum or maintenance intervals for the pump will result in visual and audible alarms.
h. The control system provides automatic lead/lag sequencing and automatic alternation of all pumps.
i. Building automation communication gateway with BacNet® protocol and Web server features. Web server features include email notifications in case the system is in alarm or has achieved one its maintenance intervals and requires service.
j. Ethernet port for connection to BacNet ® server or direct connection to facility Ethernet for viewing of system operations and status via device IP-address.
    a Auto purge feature will include:
    b Control and operation of air actuated and/or
    c electric isolation and purge valves
    d 3-position mode switch (Auto-Off-Manual)
    e Pump Status (PUMP ON, PUMP READY, PUMP OFF, PUMP PURGING)
    f Pumps will run through an automatic purge cycle every 24 hours (after alternation phase), to purge any gases from the pump to atmosphere. A 3-positionswitch is provided to select automatic purge, manual purge, or purge off modes. (NOTE: Pneumatic purge isolation valves require 80 psi compressed air to be field supplied.)

2.6 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean vacuum equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for vacuum applications, according to CGA G4.1, "Cleaning Equipment for Oxygen Service."

3.2 VACUUM EQUIPMENT INSTALLATION

A. Install vacuum equipment according to ASSE 6010 and NFPA 99.

B. Equipment Mounting: Install vacuum producers on concrete bases using elastomeric pads. Comply with requirements in Division 03 Section "Cast-in-Place Concrete." Comply with

requirements for vibration isolation devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

1. Minimum Deflection: 1/4 inch.
2. Install dowel rods to connect concrete base to concrete floor, concrete work provided by others under Division 3. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.4 CONNECTIONS

A. Comply with requirements for drain piping specified in Division 22 Section "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for vacuum piping specified in Division 22 Section "Vacuum Piping for Laboratory Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

D. Connect vacuum piping to vacuum equipment, accessories, and specialties with shutoff valve and union or flanged connection.

3.5 IDENTIFICATION

A. Identify laboratory vacuum equipment system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Identify vacuum equipment system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment." and with NFPA 99.

3.6 FIELD QUALITY CONTROL FOR VACUUM EQUIPMENT

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Preparation: Perform vacuum equipment tests according to requirements in NFPA 99 for the following:

    a. System operation test.

2. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of vacuum equipment.
3. Replace damaged and malfunctioning controls and equipment.
4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed.
    b. Procedures and materials used.
    c. Test methods used.
    d. Results of tests.

D. Components will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Verify that vacuum producer outlet piping is clear.
4. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
5. Check safety valves for correct settings.

6. Check for proper seismic restraints.
7. Drain receiver tank(s).
8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
9. Test and adjust controls and safeties.

B. Verify that vacuum equipment is installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in Division 26 Sections.

D. Prepare written report documenting testing procedures and results.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train. University's maintenance personnel to adjust, operate, and maintain vacuum producers.

END OF SECTION 22 6219

SECTION 22 6700 - PROCESSED-WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes Reagent, Deionized and reverse-osmosis-water piping.

1.2 DEFINITIONS

A. PP: Polypropylene plastic.

B. PTFE: Polytetrafluoroethylene plastic.

C. PVDF: Polyvinylidene fluoride plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping with the following minimum working-pressure ratings, unless otherwise indicated:

1. Reagent-Water Piping: 100 psig, unless otherwise indicated.
2. Deionized and Reverse-Osmosis-Water Piping: 100 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of pipe and fitting indicated.

B. Welding certificates.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.

B. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

C. ASME Compliance: Comply with ASME B31.3, "Process Piping."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe and fittings from dirt and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

B. Transition Fittings: Couplings, flanges, or other manufactured fittings, same size as, with pressure rating at least equal to and ends compatible with piping to be joined.

2.3 PLASTIC PIPE AND FITTINGS

A. PP Pipe and Fittings: Made from ASTM D 4101, PP resin.

1. Manufacturers:

a. Asahi/America.
b. Fischer, George Inc.
c. IPEX Inc.
d. NIBCO INC.
e. Orion.
f. Town & Country Plastics, Inc.
g. Or equal.

2. Standard Dimensional Ratio (SDR) or Schedule 40, Pipe and Fittings: SDR pipe and fittings conforming to ASTM Standards, dimensions and socket fusion joints; Schedule

40 pipe conforming to ASTM D 2447 dimensions and socket- or butt-fusion fittings matching pipe Schedule 40 dimensions.

B. PVDF Pipe and Fittings: Made from ASTM D 3222, PVDF resin.

a. Asahi/America.
b. Fischer, George Inc.
c. NIBCO INC.
d. Orion.
e. Or equal.

2. Standard Dimensional Ratio (SDR) or Schedule 40, Pipe and Fittings: SDR pipe and fittings conforming to ASTM Standards, dimensions and socket fusion joints; Schedule 40 pipe conforming to ASTM D 2447 dimensions and socket- or butt-fusion fittings matching pipe Schedule 40 dimensions.

2.6 PLASTIC VALVES

A. PP Valves: Made from ASTM D 4101, PP resin.

1. Ball Valves: MSS SP-122, union type with socket ends and pressure rating not less than 150 psig at 73 deg F.
2. Butterfly Valves: Shall not be used on Campus.
3. Check Valves: Swing or ball type with pressure rating not less than 150 psig at 73 deg F.

B. PVDF Valves: Made from ASTM D 3222, PVDF resin.

1. Ball Valves: MSS SP-122, union type with socket ends and pressure rating not less than 150 psig at 73 deg F.
2. Butterfly Valves: Shall not be used on Campus.
3. Check Valves: Swing or ball type with pressure rating not less than 150 psig at 73 deg F.

2.7 DIAPHRAGM VALVES

Prohibited on Campus.

2.8 FLOW RESTRICTOR VALVES

A. PP Flow Restrictor Valve

B. 3/8-inch Female NPT polypropylene body and flow restrictor. Delrin retainer, acetal flow restrictor, and ethylene propylene o-rings. 125 psi maximum inlet pressure. NSF approved.

2.10 STAINLESS-STEEL VALVES

1. Conbraco.
2. Foster Valve Co.
3. Jamesbury, Inc.
4. Marvin Ball Valves; a division of Richards Industries.
5. NIBCO INC.
6. Or equal.

B. Ball Valves, NPS 2 and Smaller: MSS SP-110, 600-psig minimum CWP, **3** or **2** piece, with stainless-steel body, full-port stainless-steel ball, PTFE seals, and threaded ends.

C. Ball Valves, NPS 3 and Larger: MSS SP-72, Class 150, 2- piece, with stainless-steel body, stainless-steel ball, PTFE seals, and flanged ends.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to and of material same as, or compatible with, piping may be used in applications in this article, unless otherwise indicated.

B. Deionized and Reverse-Osmosis- Water Piping: Use any of the following piping materials for each size range:

1. Standard Dimensional Ratio (SDR) or Schedule 40 PP pipe and fittings and heat-fusion joints.
2. Standard Dimensional Ratio (SDR) or Schedule 40 PVDF pipe and fittings and heat-fusion joints.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirement apply:

1. Shutoff Duty: Use ball valves.
2. Throttling Duty: Use ball valves.

B. Valves for Deionized and Reverse-Osmosis-Water Piping: Use any of the following valves for each piping material:

1. PP Pipe and Fittings: PP plastic or Stainless-steel valves.
2. PVDF Pipe and Fittings: PVDF plastic or Stainless-steel valves.

3.3 PIPING INSTALLATION

General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of reagent, and Deionized and reverse-osmosis-water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Refer to Division 22 Section "Common Work Results for Plumbing" for general piping installation requirements.

C. Provide insulation with 1-hour fire rating to all polypropylene (PP) piping install above floor in fire resistive construction as required by NFPA, CBC and Campus Fire Marshal. Provide rated penetrations for all piping penetrating rated wall, floor or ceiling.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. PP & PDVF Piping Joints: Make heat-fusion joints similar to procedure in ASTM D 2657 for polyolefin piping joints.

C. Stainless-Steel Pressure Tubing Joints: Make butt-welding joints without use of filler metal. Polish exterior to match tubing.

D. Joint dissimilar pipe materials with transition fittings compatible with pipe materials being joined.

3.5 VALVE INSTALLATION

A. Refer to Division 22 Section "Domestic water piping and Valves".

B. Install sectional valves close to mains on each branch and riser serving equipment.

C. Install shutoff valve on each supply to each equipment.

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing."

B. Pipe hanger and support devices and installation requirements are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Clamps for Vertical Piping: MSS Type 8 or Type 42.

2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

C. Support horizontal piping and tubing in accordance with CPC requirments.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch.

F. Install padded hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters in accordance with CPC requirements.

G. Install padded supports for vertical PP piping in accordance with CPC requirments.

H. Install padded hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters in accordance with CPC requirements.

I. Install padded supports for vertical PVDF piping in accordance with CPC requirements .

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect deionized and reverse-osmosis-water piping to equipment and service outlets with unions or flanges.

3.8 LABELING AND IDENTIFICATION

A. Install pipe markers and valve tags on piping. Distinguish between different systems and include direction of flow indication on each pipe. Labeling and identification devices are specified in Division 22 Section "Identification for Plumbing."

3.9 FIELD QUALITY CONTROL

A. Test new piping and parts of existing piping that have been altered, extended, or repaired, for leaks and defects.

1. Schedule tests and their inspections by University’s Representative, with at least 72 hours' advance notice.
2. Do not cover or put into service before inspection and approval.

3. Test completed piping according to CPC. If CPC does not have published procedures, perform tests as follows:

    a. Hydrostatic Tests: Test piping at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 100 psig.
    b. Exception: Do not subject glass piping to pressure above manufacturer's pressure rating for size.

4. Replace leaking joints with new materials and retest until no leaks exist.
5. Submit separate reports for each test.

3.10 CLEANING

A. Use procedures prescribed by University's Representative or, if not prescribed, use procedures described below:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Clean piping by flushing with system reagent or Deionized and reverse-osmosis water.

END OF SECTION 22 6700

SECTION 22 6701 – PROCESSED-WATER EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes a complete processed-water system consisting of the following.

1. Activated carbon filter.
2. Pre-filter
3. Reverse Osmosis unit.
4. Ultra-violet sterilizer
5. Deionizers
6. DI Cartridge filter
7. Storage tank
8. RO/DI system
9. Chemicals.
10. Water testing kits.

B. Related Sections include the following:

1. Division 22 Section 22 6700 "Processed-Water Piping" for piping, valves, hangers and supports.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. NBR: Acrylonitrile-butadiene rubber.

D. PE: Polyethylene plastic.

E. ppm: Parts per million.

F. PVC: Polyvinyl chloride plastic.

G. PP: High purity Virgin un-pigmented polypropylene piping.

H. PVDF: Polyvinylidene fluoride plastic.

1.3 SYSTEM DESCRIPTION

A. Equipment Supplier/Manufacturer's Scope of Work:

1. Equipment Manufacturer shall provide all new equipment as detailed in this specification; transport to the job site; completely install and pipe: and provide efficiently operating automatic system.
2. The equipment manufacturer shall start up the system, completely sanitize and provide training for University personnel.
3. Provide (4) four copies of operations and maintenance manuals.
4. Provide rental and exchange units, based on separate service contract with University.

1.4 DESIGN REQUIREMENTS

A. System Parameters:

1. Feed water quality: Riverside city water
2. Required product water quality: ASTM Type II
3. Resistivity, min: 7 megohms-cm
4. Bacteria, subset B max count: 10/100 mL
5. Silica, max: 3 ug/L
6. Total Organic Carbon, max: 50 ug/L
7. Chlorides, max: 5 ug/L
8. Sodium, max: 5 ug/L
9. Usage period: 24 hours per day, 7 days per week
10. Maximum Instantaneous use rate: Estimated to be 40 gpm at the sinks.
11. Estimated to be 15 gpm each of the autoclaves
12. Daily water usage: Estimated to be 2,000 gallons per day plus future total maximum capacity to be 4,000 gallons per day.
13. Piping between equipment: Schedule 80 PVC. PVC not allowed beyond equipment room.
14. Distribution loop: GF PRO Polypropylene pipe RO/DI loop size per plans.
15. Flow rate requirements for distribution loops: Estimated 70 gpm for RO/DI loop
16. Pressure requirements for distribution loop: Estimated to be minimum 25 psi required at sinks and equipment.
17. Application: Makeup and rinse water for laboratory bench applications, washer equipment, and equipment use including cage wash rinse and humidifiers.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated and include the following:

1. All purified water equipment include rated capacities, operating characteristics, furnished specialties, and accessories.
2. Water testing kits.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Include plans, elevations, sections, details, and connections to piping systems.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that indicated steel mineral tanks, accessories, and components will withstand seismic forces defined in Division 22 Section 22 0548 "Vibration and Seismic Controls for Plumbing." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Manufacturer Certificates: Signed by manufacturers certifying that purified water systems comply with requirements.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Startup service test reports.

H. Operation and Maintenance Data: For Purified Water system to include in emergency, operation, and maintenance manuals.

I. Warranty: Special warranty specified in this Section.

J. Maintenance service agreement.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of water filtration equipment through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of purified water systems and are based on the specific system indicated. Refer to Division 1 Section 01 6000 “Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.8 WARRANTY

A. Warranty: University's standard form in which contractor agrees to repair or replace components of purified water system that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures of mineral, storage and brine tanks.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.
d. Attrition loss of resin exceeding 3 percent per year.
e. Mineral washed out of system during service run or backwashing period.
f. Effluent turbidity greater and color darker than incoming water.
g. Fouling of under-drain system, gravel, and resin, with turbidity or by dirt, rust, or scale from softener equipment or soft water, while operating according to manufacturer's written operating instructions.

1.9 MAINTENANCE SERVICE

A. Maintenance: Submit four copies of manufacturer's "Agreement for Continued Service and Maintenance," before Substantial Completion, for University's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Include one-year term of agreement with option for one year renewal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with the provisions in Division 1, Section 01 6000 "Product Requirements", Part 2 "Product Substitutions", article. Specific procedures must be followed before use of an unnamed product or manufacturer.
3. Manufacturers:

    a. SOUTH COAST WATER, a Division of Hannah Industries (www.sch2o.com)
    b. Evoqua Water Technologies.
    c. Columbia Water Conditioned System Inc.
    d. Rain Soft Division
    e. Or equal.

2.2 EQUIPMENT

A. Based on the system parameters as defined in Section 1.4, recommends the following equipment is recommended:

B. One (1) SCW Reverse Osmosis, Deionization Upright Skid # SCWRODIPOST4K70, or equal.
1. 4000 gallon per day reverse osmosis.
    a. One (1) I Control ROC 2 Reverse Osmosis controller; Readings: TDS product and reject, percent rejection, low feed pressure, run time, pretreatment lockout, high level on/ off.
    b. Three (3) Axeon H5 4X40 thin film membranes staged 2-1 housed in Axeon PVC housings.
    c. One (1) Fluid O Tech high pressure pump coupled to a 1 HP Baldor motor, 110 volt single phase TEFC.
    d. Two (2) Blue and White flow meters, product and reject F-4550LE8 and F-45500LA-8.
    e. Two (2) 0-160 LF Stainless pressure gauges.
    f. Two (2) Pre filters, 1-5 micron carbon and 1 20" carbon.
    g. One (1) TOC Reducing unit Viqua Pro10
2. Distribution Pumps
    a. Two (2) GOULD's 15SV4FH4C60 7.5HP 3Phase 304 SS Vertical pumps.
    b. Two (2) HOA starters.
    c. Two (2) 0-160 LF Stainless pressure gauges
3. Post Treatment
    a. Sixteen (16) 1447 3.5 cubic foot Mixed Bed DI running 8 into 8 as series
    b. Four (4) 40" 5 micron filters, Housed in SHELCO multi housing 304 stainless steel 4FOS4
    c. Five (5) 40" 0.2 micron filters, housed in SHELCO multi housing 304 stainless steel 5FOS4
    d. Five (5) 40" Endotoxin filters, housed in SHELCO multi housing 304 stainless steel 5FOS4
    e. Two (2) Ultraviolet Sterilizers Atlantic model S2400 40 GPM each
    f. One (1) Myron L Quality Monitor 0-18 MEG/OHM digital readout with 4-20 ma output.

C. Equipment off Upright Skid.

1. One (1) PE Carbon exchange tank pretreat to RO, 1 cubic foot 10X40.
2. One (1) Four bed PE DI installed after RO before Storage.
3. Sixteen (16) 1447 3. cubic foot Mixed Bed DI running 8 online 8 standby.
4. Three (3) SHELCO filter housings.
5. Two (2) S2400 UV Sterilizers.

D. Return Loop

1. One (1) 2" PLASTOMATIC Pressure reducing valve PVC, RVT 200PV.

2.4 COMMERCIAL WATER SOFTENERS

A. RO/DI feed water source from building soft water exchange system.

2.6 WATER TESTING SETS.

A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

2.7 SOURCE QUALITY CONTROL

A. Hydrostatically test mineral tanks before shipment to minimum of one and one-half times pressure rating.

B. Prepare test reports.

PART 3 - EXECUTION

3.1 INTERFACE WITH OTHER WORK

A. Design Builders' Scope of work:

1. Provide a 6" high, approximately 20' x 30' equipment concrete pad with 4' clearance all around, capable of supporting equipment operating weight of 70,000 lbs. With mainly about 50,000 lbs. Weight of the RO water Storage Tank. The location must be accessible for transportation; temporary storage of equipment and transportation to the pad. Provide a forklift to offload the equipment and set in place.
2. Provide a minimum 3" ball valved city water stub out at the location required by the system installer, providing at least 130 gpm at 60 psi, continuous flow. Provide reduced pressure backflow preventer and a 3" pressure regulating valve upstream of the stub out.
3. Provide drains, vented to the atmosphere and located at and around equipment pad, capable of draining 3 gpm from RO reject, 50 gpm from softener, rinse of the DI units and draining of the storage tank.
4. Electric power: Provide 480V/3PH/60HZ/15 AMPS to RO electrical panel, 480V/3PHG/60HZ/20 AMPS to the distribution pumps electric panel,

110V/1PH/60HZ/20 AMPS to Softener and 110V/1PH/60HZ/20 AMPS to equipment pad. All electrical shall dedicated circuits with beakers or fuse protection.

5. Provide 2" ball valved PP stub outs for pure water supply and return distribution loop at the required locations at the equipment pad. The PW distribution loop shall be High purity virgin non-pigmented polypropylene piping.
6. Provide adequate access for the installer for installation and service.
7. Provide all required work by the other trades.
8. Provide a 1" ball valved stub out for extending the pure water to humidifiers.
9. Provide a PRV immediately at start of the distribution loop to control the excessive pressure build up.

3.2 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of water softeners and other filtered water equipment.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls and floors for suitable conditions where water softeners and other filtered water equipment will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 CONCRETE BASES

A. Install concrete bases of dimensions required for commercial purified water systems. Refer to Division 22 Section 22 0500 "Common Work Results for Plumbing."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevation required for proper attachment to supported equipment.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.4 PURIFIED WATER SYSTEM INSTALLATION

A. Install commercial purified water system equipment on concrete bases, level and plumb. Maintain manufacturer's and UCR recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor mounting accessories to substrate.

B. Submit equipment list and flow and piping diagrams to University Representative for review and approval. All recommended changes shall be incorporated.

C. Install seismic restraints for freestanding cartridge filters, tanks and floor-mounting accessories and anchor to building structure.

D. Install filter elements in cartridges.

E. Install water testing sets mounted on wall, unless otherwise indicated, and near purified water systems.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between dissimilar-metal water piping with dielectric fittings. Dielectric fittings are specified in Division 22 Section 22 0500 "common Work Results for Plumbing."

D. Install shutoff valves on feedwater-inlet and filtrate-outlet piping of each water filtering equipment**,** and on inlet and outlet headers and on inlet and outlet headers.

1. Plastic valves are specified in Division 22 Section 22 6700 "Processed Water Piping."
2. Exception: Water processing equipment with factory-installed shutoff valves at locations indicated.

E. Install pressure gages on soft feedwater-inlet and processed piping of each water processing equipment. Pressure gages are specified in Division 22 Section 22 0519 "Meters and Gages for Plumbing."

1. Exception: Water processing equipment with factory-installed pressure gages at locations indicated.
2. Exception: Cartridge water filter.

F. Install valved bypass water piping around each water processing equipment process.

1. Plastic valves are specified in Division 22 Section 22 6700 "Processed Water Piping."
2. Water piping is specified in Division 22 Section 22 6700 "Processed Water Piping."
3. Exception: Cartridge water filtration equipment.

G. Install drains as indirect wastes to spill into open drains or over floor sinks. Piping shall be routed around floor so as not to cause a tripping hazard.

H. Ground equipment per Division 26 Section 26 0526 "Grounding and Bonding for Electrical Systems."

I. Connect wiring per Division 26 Section 26 2200 "Low Voltage Power Conductors and Cables."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning processing water systems that do not pass tests and inspections and retest as specified above.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

B. Sample pure water from the most remote location on the highest floor distribution loop, after the start up and three consecutive seven day intervals (Total of four samples taken from the same location) and provide certified test report prepared by an independent testing lab to show that the water meets performance characteristics specified in Section 1.4-A, lines 1 through 8. Design Requirements, System Parameters. Comply with the following:

1. ASTM D 859, "Test Method for Silica in Water."
2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D 1129, "Terminology Relating to Water."
4. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

C. Sample soft water similarly and provide similar certificates. Comply with the following:

1. ASTM D 1068, "Test Methods for Iron in Water."
2. ASTM D 1126, "Test Method for Hardness in Water."

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain processing water systems. Refer to Division 1 Section Project Closeout.

END OF SECTION 22 6701

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Mechanical demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within concrete pipe trench and unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.

4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following if proposed to be used on this project:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1. Certificates shall be applicable for materials to be joined at the job-site.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel." ASME Section VIII.

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed NCPW or AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Piping penetration through fire-rated construction assemblies, including accessory components; sleeves, sealants, packing materials and methods, and installation shall meet the requirements of the CBC, and shall be California State Fire Marshal approved. Firestopping details shall bear the UL label, indicate F-rating, T-rating, and shall meet the requirements of the California Building Code.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames." Coordinate to avoid access panels at hard lid ceiling if possible. Access panel shall be located in accessible area for maintenance convenience and safety and limit disturbance to the public.

D. Coordinate with other sections of the specifications for the applicability of materials specified in this section. Not every product or material listed may be used.

E. Coordinate requirements of this section with actual work to be performed. This section is general in scope for basic materials and methods, all of which may not actually apply to this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: Bolts shall be United States Customary System bolts and nuts (e.g. ¾"). Metric bolts and nuts shall not be used for CHW and HHW. Bolts and nuts shall be 2' electro-galvanized for indoor applications and SAE Grade hot-dip galvanized steel or stainless steel with heavy hex nuts for outdoor application . For steam and steam condensate return applications, bolts shall meet ASTM A193 Grade B7 and nuts shall meet ASTM A194 Grade 2H. Except for manufacture supplied.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813 Alloy E.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Dresser Industries, Inc.; DMD Div.
    c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    d. JCM Industries.
    e. Smith-Blair, Inc.
    f. Viking Johnson.
    g. Or equal.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solderjoint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Shall not be used. Provide 6" long brass nipple with brass unions or brass couplings. Or brass union and bronze ball valve on ends of nipple.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, fullface- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Or equal.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.
c. Or equal.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Precision Plumbing Products, Inc.
b. Sioux Chief Manufacturing Co., Inc.
c. Victaulic Co. of America.
d. Or equal.

2.1 MECHANICAL SLEEVE SEALS

G. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Calpico, Inc.
b. Metraflex Co.
c. Pipeline Seal and Insulator, Inc.
d. Thunderline Modular Seals; Link-Seal
e. Or equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
5. Link-Seal shall be basis of design.

2.6 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends on exterior walls only.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms. Acceptable only for concrete foundation walls below grade.

F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings or custom bends for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors in exposed areas in public spaces according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castbrass type with polished chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Mounting hardware, including nuts, bolts and washers for outdoor applications and below grade applications must be of stainless steel materials.

N. Sleeves are not required for core-drilled holes, except in Group L type occupancy, and other locations where spill control is needed.

O. Permanent sleeves are not required for holes formed by removable PE sleeves.

P. Install sleeves for pipes passing through interior concrete and masonry walls, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For Group L occupancies, mechanical rooms, and wet area applications where spill containment is required.
b. Steel Sheet Sleeves: For applications not requiring spill containment.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing.

Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

d. Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

5. Where required, sleeve application and installation shall comply with UL approved Firestopping Detail.

6. Coordinate requirements of sound-proofing caulk, as determined by the Sound and Vibration Consultant's recommendations.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install steel "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials per UBC requirements. Refer to Division 07 Section "Penetration Firestopping" for material and installation requirements. Piping penetration through fire-rated construction assemblies, including accessory components; sleeves, sealants, packing materials and methods, and installation shall conform to Underwriters Laboratories Listed firestop systems. T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

V. Install valves in readily accessible locations, avoiding hard-lid ceilings where possible. Provide access panels for valve access complying with Division 08, and coordinate access panel locations with other disciplines.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Oxyacetylene torch welding, and cutting of structural steel or bolt holes shall not be permissible.

E. Install main and branch piping using tee fittings, “T-drill”, “welded nozzles”, or “SideTap” or Pro Press.

F. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

G. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

I. Welded Joints: See Section 23 0511 “Welding Pressure Piping.”

J. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install shut-off valves at final connection to each piece of equipment.
2. Install unions, in piping NPS 2″ and smaller, at final connection to each piece of equipment or flanges.
3. Install flanges, in piping NPS 2-1/2″ and larger, at final connection to each piece of equipment.
4. Dry Piping Systems: Install dielectric flanges to connect piping materials of dissimilar metals.
5. Wet Piping Systems: Install brass union, or brass coupling ball valve and brass nipple

fitting to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Grease fittings shall be installed in accessible locations. Extended lube lines are not acceptable.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09 Section "High Performance Coatings" by painting contractor.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to CBC seismic zone 4 requirements by General Contractor.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, vibration isolator, or seismic restraint. Provide 1inch chamfer at all corners and round over edge.
2. Install dowel rods to connect concrete base to concrete floor. Install dowel rods on 18inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor when required by structural engineer.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Minimum embedment shall comply with seismic engineer’s calculations.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. General Contractor to provide 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

D. Outdoor Applications: Outdoor support assemblies and accessories shall be of "stainless steel material", or "hot-dip galvanized carbon steel with high-performance coatings", as noted below:

1. Stainless steel: Mounting hardware such as bolts, nuts, washers, straps, brackets, fastening hardware etc., shall be stainless steel.

2. Coated galvanized steel: Carbon steel support assemblies, including all metal fabrications for use outdoors shall comply with each paragraph listed below:

a. Assemblies must be shop-fabricated and pre-assembled for one-piece hot-dip galvanized coating process

b. Touch-up and repair per manufacturer's recommendations after field installation.

E. Rooftop Applications: Rooftop support assemblies and accessories shall be fabricated for outdoor applications as noted above, and shall be designed per SMACNA design requirements.

1. SMACNA Clearances: Pipes, pipe racks, and equipment shall be installed high enough above roofing surfaces to allow roofing access for maintenance and repair. Install piping and equipment at a minimum height as shown in Table 4-1 of SMACNA Architectural Sheet Metal Manual – 5th Edition.
2. SMACNA Support Systems: Piping systems and equipment supports, unless otherwise shown, use round column supports to tie-in to structure with lead jacks for built-up roofs, and single-ply preformed jacks for single-ply roofs, lead flashing, and lead umbrellas with stainless steel draw band per Figure 4-16A, or Figure 4-16B, of SMACNA Architectural Sheet Metal Manual – 5th Edition.

3.8 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 0500

SECTION 23 0510 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-state, Pulse Width Modulated (PWM) and Vector Control, VFDs for speed control of three-phase, squirrel-cage induction motors for plumbing and HVAC equipment.

B. Related Sections include the following:

1. Division 23 Section “Instrumentation and Controls” for BMS interface for monitoring and control.
2. Division 26 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
3. Division 26 Section "Fuses" for fuses in fusible switches.

1.2 DEFINITIONS

A. PWM: Pulse-width modulated.

B. VFD: Variable frequency drive (may be referred to as “VSD” or “variable speed drive”, in other sections of the proposal documents).

1.3 SUBMITTALS

A. Product Data: For each type of VFD, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, installation instructions and finishes.

B. Shop Drawings: For each VFD.

1. Include VFD dimensions, required clearances, and service space around equipment. Show location of installed devices, and equipment features. In submittal information Include the following:

    a. Each installed unit's type and details.
    b. Nameplate legends.
    c. Short-circuit current ratings of integrated unit.
    d. VFD UL listing for series rating of over-current protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring for VFD. Provide schematic wiring diagram for each type of VFD.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around VFDs where pipe and ducts are prohibited. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Qualification Data: For testing agency and manufacturer.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For VFDs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section " Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for VFDs and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain VFDs of a single type through one source from a single manufacturer for every VFD required for the project.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University’s Representative, and marked for intended use.

D. Design: VFDs shall meet requirements of IEC 801-2, IEC 801-4, IEC 255-4.

E. Product Selection for Restricted Space: Coordinate maximum dimensions for VFDs, minimum clearances between VFDs, and adjacent surfaces and other items. Comply with manufacturer’s recommended clearances.

F. Comply with CEC (NFPA 70).

G. VFDs and by-pass, if applicable, shall be manufactured and tested in the United States of America.

H. VFD Manufacturer shall perform the following:

1. Control power test.
2. No Load test.
3. Partial Load test, at 10 Hz.
4. Full Load test (full amperage).
5. Voltage detection testing.

6. Calibration test.

I. VFDs shall be UL listed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver VFDs in shipping splits of lengths that can be moved past obstructions in delivery path.

B. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subject to weather, cover VFDs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 COORDINATION

A. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

D. Coordinate features of VFDs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each VFD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

F. Coordinate with Division 26 on location of VFDs and disconnect switch. Coordinate flexible electrical connections, and travel requirements, on spring/rubber isolated equipment such as fans, pumps, and other equipment. Avoid unnecessary duplication of disconnect switch if provided integral with VFDs and fuse protection is provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen Bradley
2. Danfoss
3. Toshiba International Corporation.
4. Or equal.

B. Description: NEMA ICS 2, FWR, IGBT, PWM, PW rating of 1600 volts, VFD; listed and labeled as a complete unit and arranged to provide variable frequency of a NEMA MG 1, Design B, 3-phase, premium -efficiency induction motor by adjusting output voltage and frequency. Drives 60 HP and larger shall use direct torque control technology.

C. Configuration

1. For parts interchangeability purposes, VFDs shall have the same customer interface and control logic board, including digital display, keypad and control connections; regardless of horsepower rating. VFDs from 2 HP to 400 HP shall have the same operator interface and keypad. The keypad is to be used for local control (start/stop, hand, off, auto, forward/reverse, and speed adjust), for setting parameters, and for stepping through the displays and menus.
2. The VFD shall give the user the option of either (1) displaying a fault, or (2) running at a programmable preset speed if the input reference (4-20mA or 2-10V) is lost; as selected by the user.
3. The VFD's shall utilize digital display in English. The digital display shall be a 30character (2 line x 16 characters/line,) LCD display. The screen shall be backlit to provide easy viewing in any light condition. The contrast should be adjustable to optimize viewing at any angle.
4. The Drive shall have local-remote for speed control and manual-auto for start-up. When in "Local", the VFD will be started, and the speed will be controlled from the speed up or speed down keypads. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.
5. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to set point without safety tripping or component damage (flying start). Coast to stop before restart shall not be required.
6. VFD's to have the following adjustments:

    a. Three (3) programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.
    b. PID Set point controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control; thus eliminating the need for external controllers. Drives not utilizing a PID controller shall provide a field installed controller provided by the

drive manufacturer for field mounting or shall incorporate a floating point controller utilizing a Dwyer Photohelic factory mounted in the drive panel.

c. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference, or for reference and actual signals for PID controller. Analog inputs shall include a filter, programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20 mA and 0-10 volts.

d. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.

D. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

F. Unit Operating Requirements:

1. Input ac tolerance of 200V +/-10% at 48-63 Hz for nominal 208V systems, and 460V +/10% at 48-63 Hz for nominal 480 V systems.
2. Capable of driving full load, under the following conditions, without derating:

a. Ambient Temperature: 0 to 40 deg C.
b. Humidity: Less than 95 percent (non-condensing).
c. Altitude: 3300 feet.

3. Minimum Efficiency: 98 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor: 98 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
6. Starting Torque: 150 percent of rated torque.
7. Speed Regulation: Plus or minus 1 percent.
8. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

G. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

H. Self-Protection and Reliability Features:

1. The drive shall employ two current limit circuits to provide trip free operation:

a. The Rapid Current Regulation limit shall be adjustable from 50% to 180% of the VFDs variable torque current rating. If the motor current exceeds the current limit setting, the drive shall stop, and decrease the output frequency until the motor current is reduced below the current limit level, at which time the output frequency shall accelerate (at the rate set by the acceleration time) to the set frequency. The rapid current regulation shall allow up to 200% current to be drawn for a short period of time before the current is reduced to the slow current regulation limit.
b. The Slow Current Regulation limit circuit shall be adjustable from 50% to 350% of the VFDs variable torque current rating. This current regulation operates similarly to the rapid current regulation, except at a slower rate. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.

2. The overload rating of the drive shall be 110% of its variable torque current rating for 1 minute every 10 minutes, and 115% of its variable torque current rating for 2 seconds every 10 seconds.
   a. The VFD shall have a 65,000 Amp short circuit rating protection without the need of semi-conductor fuses.
   b. The Customer terminal strip shall be isolated from the line and ground.

3. Motor thermal protection shall be accomplished with connection to the klixon thermisters provided by motor manufacturer.

4. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words.
   a. Over current trip limit: 3.5 x In instantaneous of the VFD's variable torque rating
   b. Over voltage trip limit: 1.35 x Vr (rated voltage)
   c. Under voltage trip limit: .65 x Vn
   d. Over temperature (heat sink): + 203 degrees F
   e. Auxiliary voltage: ground fault protected
   f. Ground Fault: Protected
   g. Short circuit: Protected
   h. Microprocessor fault: Protected
   i. Motor stall protection: Protected
   j. Motor over-temperature protection (I2t): Protected
   k. Loss of reference: Protected
   l. Input power loss of phase: Protected

5. Input transient protection by means of surge suppressors.
6. Snubber networks to protect against malfunction due to system voltage transients.
7. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
8. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 20 performance.
9. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
10. Instantaneous line-to-line and line-to-ground overcurrent trips.

11. Loss-of-phase protection.
12. Reverse-phase protection.
13. Short-circuit protection.
14. Motor overtemperature fault.

I. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.

J. Automatic Reset and Restart: To attempt restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load. (The number of restart attempts and trail duration period shall be programmable.)

K. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

L. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

M. VFD Compliance to IEEE 519 will be determined after the drive manufacturer completes a full harmonic analysis. Electrical drawings must be made available to manufacturer for review. If additional filters or reactors are required manufacturer shall comply. VFD Output Filtering: VFD Output filtering shall be considered for long VFD to motor line lengths (over 100 feet). Consideration for filtering shall be given during IEEE 519 analysis. If required, manufacturer shall comply.

N. Panel-Mounted Operator Station: Start-stop and speed control are functions of system key pad.

O. Indicating Devices: VFD keypad and display shall indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFD with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.

2. Pneumatic Input Signal Interface: 3 to 15 psig.
3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

    a. 0 to 10-V dc.
    b. 0-20 or 4-20 mA.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.
    e. RS485.
    f. Keypad display for local hand operation.

4. Output Signal Interface:

    a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

        1) Output frequency (Hz).
        2) Output current (load).
        3) DC-link voltage (VDC).
        4) Motor torque (percent).
        5) Motor speed (rpm).
        6) Set-point frequency (Hz).

5. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.
    b. Set-point speed reached.
    c. Fault and warning indication (overtemperature or overcurrent).
    d. PID high or low speed limits reached.

Q. VFD Serial Communications with Siemens or Johnson Controls systems:

1. The VFD shall have an RS-485 port as standard.
2. To communicate with Siemens FLN control systems, the variable frequency drive must, as a minimum, be able to accomplish functions of: runstop control, speed set adjustment, proportional/integral gain adjustments, RPM feedback, kilowatt-hour feedback, drive and motor temperature feedback, and warning/fault diagnostics across the serial port. Serial communication shall be accomplished through a EE-Prom integral to the VFD. Communication gateways or hard wiring for each individual point shall not be required. The VFD manufacturer's serial communication protocol, software and product must be officially approved and endorsed by the DDC control company, and a letter from the DDC control manufacturer shall be furnished upon request.

R. Manual Bypass: Arrange magnetic contactor to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable

operation (starting, stopping, and running), with motor completely disconnected from controller (no load).

S. Isolating Switch: Non-load-break switch arranged to isolate VFD and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

T. Bypass Controller: NEMA ICS 2, full-voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

U. Integral Disconnecting Means: NEMA KS 1, fusible switch with lockable handle.

2.3 ENCLOSURES

A. The VFD enclosure shall be rated NEMA 4 for outdoor units, NEMA 12 (with NEMA 12 Keypad) for indoor units.

2.4 ACCESSORIES

A. If IEEE 519 analysis indicates requirement Manufacturer shall comply: Provide a 3% impedance input Line Reactor for lower harmonic distortion on the power line and improved displacement power factor. The line reactor shall be integral to the drive and the drive performance shall be based on the drive including the integral line reactor as a standard feature. The line reactor shall be 1-1/2% on each of the positive and negative legs on the input side of the DC Bus Link.

B. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

C. Historical Logging Information and Displays:

1. Total run time.
2. Fault log, maintaining last four faults.

D. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 UNACCEPTABLE FEATURES

A. The following design and/or construction features will not be acceptable for use on this particular project:

1. Drive efficiencies of less than 97% at full rating are not acceptable.
2. Phase Control Rectifiers (Thyristors) or other such devices causing line notching are not acceptable.

3. VV1, six-step, and current source drives are not acceptable.
4. Drives requiring external fusing are not acceptable.
5. Function and/or fault indications that are in code or require reference to an operating manual or any methods not using direct reading English words are not acceptable.
6. SCR'S GTO'S and Darlington transistors are not acceptable.

2.6 FACTORY FINISHES

A. Manufacturer's standard finish suitable for area of installation. Units are not to be field painted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Install VFD mounting to walls in accordance with manufacturer’s installation instructions.

B. Large drives may be floor mounted. Install VFDs on concrete bases complying with Division 03 Section "Cast-in-Place Concrete."

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 IDENTIFICATION

A. Identify VFDs, components, and control wiring according to Division 23 Section "Common Work Results for HVAC."

B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFDs and remote devices according to Division 26 Section "LowVoltage Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where available.

1. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment.

C. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each VFD element, bus, component connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
2. VFD Failure analysis: VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and de-cap or de-laminate of components and analyze failures within the components.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. VFD Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, and perform testing and adjusting of VFDs.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 CLEANING

A. Clean VFDs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain VFDs. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 0510

SECTION 23 0511 - WELDING PRESSURE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section applies to welding of steel piping provided under Division 23.

B. Related Sections include the following:

1. Division 23 Section "Common Work Results for HVAC" for general piping materials and installation requirements.
2. Division 23 Section "Vibration and Seismic Controls for HVAC."
3. Division 23 Section "Hangers and Supports for HVAC" for pipe supports, product descriptions, and installation requirements.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. ANSI Z49.1 - Safety in Welding and Cutting.

C. ASME-01 - Boiler and Pressure Vessel Code; Section I, Power Boilers.

D. ASME-04 - Boiler and Pressure Vessel Code; Section II, Material Specifications, Part C Specifications for Welding Rods, Electrodes and Filler Metals.

E. ASME-14 - Boiler and Pressure Vessel Code; Section V, Nondestructive Examination.

F. ASME-17 - Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications.

G. ASME B31.1 - Power piping.

H. ASME B31.9 - Building Services Piping

I. ASNT-01 - Recommended Practice SNT-TC-1A.

J. ASNT-02 - Question and Answer Book A (Supplement to Recommended Practice SNT-TC-1A).

K. ASNT-03 - Question and Answer Book B: Magnetic Particle Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A).

L. ASNT-04 - Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A.

M. ASNT-05 - Question and Answer Book D: Liquid Penetrant Testing Method; Levels I, II, III (Supplement to Recommended Practice (SNT-TC-1A).

N. AWS A2.4 – Symbols for Welding, Brazing and Nondestructive Examination

O. AWS A3.0 – Welding Terms and Definitions Including Terms for Brazing, Soldering Thermal Spraying and Thermal Cutting.

1.3 SUBMITTALS

A. Certificates: Welding Certificates applicable to the material being joined.

B. Pressure Piping: Detail drawings showing location, length, and type of welds; and indicating postweld heat treatment and NDE as required.

C. Qualifications: Welder and welding operator performance qualification certificates. Welding inspectors and NDE personnel certificates. Qualifications of testing laboratory or the Contractor's quality assurance organization.

D. Welding Operations: Detailed procedures that define methods of compliance to contract drawings and specifications. Inspection and material procurement records. System and material testing and certification records. Written records and drawings indicating location of welds made by each welder or welding operator.

1.4 DEFINITIONS

A. Definitions shall be in accordance with AWS A3.0.

1.5 GENERAL REQUIREMENTS

A. This Section covers the welding of pressure piping systems. Procedures shall be developed for welding all metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. An approved testing laboratory shall perform qualification testing. Maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination. The procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses shall be qualified. ASME B31.1 or ASME B31.9, as applicable, requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

1.6 PERFORMANCE

A. Provide quality joint preparation, welding, and examination. All materials used in the welding operations shall be clearly identified and recorded. The inspection and testing defined in this

specification are minimum requirements. Additional inspection and testing shall be the responsibility of the Contractor when he deems it necessary to achieve the quality required.

1.7 QUALIFICATIONS

A. Certification

1. Each welder shall have passed a qualification test. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications," ASME Section VIII.
2. The certifications shall certify that the welder is qualified to weld the material to be used at the job site.
3. Submit copies of each welder's certifications for approval prior to commencing the work. No welder shall be used on the project until so certified.

B. Welding Procedures Qualification: Record in detail and qualify the Welding Procedure Specifications for every welding procedure proposed. Qualification for each welding procedure shall conform to the requirements of ASME B31.1 or ASME B31.9, as applicable, and to this specification. The welding procedures shall specify end preparation for butt welds including cleaning, alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required or specified. The type of backing rings or consumable inserts, if used, shall be described and if they are to be removed. Welding procedures shall be identified individually and shall be referenced on the detail drawings.

C. Welder and Welding Operator Performance: Each welder and welding operator assigned to work shall be qualified in accordance with ASME B31.1 or ASME B31.9, as applicable,

D. Inspector Certification: Welding inspectors shall be qualified in accordance with AWS QC1.

E. NDE Personnel: NDE personnel shall be certified, and a written procedure for the control and administration of NDE personnel training, examination and certification shall be established. The procedures shall be based on appropriate specific and general guidelines of training and experience recommended by ASNT-01.

1.8 DELIVERY, STORAGE AND HANDLING

A. All filler metals, electrodes, fluxes, and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used.

B. Material Control: Materials shall be stored in a controlled access and clean, dry area that is weathertight and is maintained at a temperature recommended by the manufacturer. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing.

1.9 SYMBOLS

A. Symbols shall be in accordance with AWS A2.4.

1.10 SAFETY

A. Safety precautions shall conform to ANSI Z49.1.

PART 2 - PRODUCTS

2.1 WELDING MATERIALS

A. Welding materials shall comply with ASME-04. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 - EXECUTION

3.1 WELDING

A. Do not deviate from applicable codes, approved procedures and approved shop drawings without prior written approval from the University's Representative. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this specification unless otherwise specified. Assign each welder or welding operator an identifying number, letter, or symbol that shall be used to identify his welds. Each welder or welding operator shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, place identification marks adjacent to the welds at 3 foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater.

3.2 WELDING OPERATORS

A. Perform welding in accordance with qualified procedures using qualified welders and welding operators.

3.3 WELDING PROCEDURES

A. Welding procedure (except for HTW piping):

1. Electric metallic arc process shall be used on all welding. End preparations shall conform to ANSI and ASTM Standards. Welding shall be per ASME standards. Cutting by oxyacetylene torch shall be in accordance with ASME B31.1 or ASME B31.9, as applicable.

2. Use only one welder for each joint.
3. Branch pipe shall be welded to mains with thread-o-let, weld-o-let, sock-o-let other manufactured fittings or fabricated fittings per B31.9 criteria.
4. Weld slip-on flanges on both front and backsides.
5. Thermometer and test wells shall be threaded and installed with thread-o-let fittings.

3.4 SUPPORTS

A. Welding of hangers, supports, and plates to structural members shall conform to AWS D1.1.

3.5 EXAMINATIONS, INSPECTIONS AND TESTS

A. Visual and nondestructive examinations shall be included in the contract to detect surface and internal discontinuities in completed welds. Employ the services of a qualified commercial inspection or testing laboratory or technical consultant approved by the University. Visually examine welds. Radiographic, Liquid penetrant, Magnetic particle, or Ultrasonic examination shall be required as indicated or in accordance with other sections where detailed requirements are specified. When examination and testing indicates defects in a weld joint, a qualified welder shall repair the weld in accordance with the paragraph entitled "Corrections and Repairs" of this section.

B. Visually examine welds as follows:

1. Before welding -- for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alinement and fit-up, and cleanliness.
2. During welding -- for conformance to the qualified welding procedure.
3. After welding -- for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

C. NDE shall be in accordance with written procedures. Procedures for radiographic tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the University’s Representative. In addition to the information required in ASME BPVC SEC V, the written procedures shall include:

1. Timing of the nondestructive examination in relation to the welding operations.
2. Safety precautions.

D. Examinations and Tests by the University

1. Examinations and tests will conform to paragraphs "Visual Examination" and "Nondestructive Examination" of this section, except that destructive tests may be required also. When destructive tests are made, qualified welders or welding operators shall make repairs using welding procedures which will develop the full strength of the members cut. Welding shall be subject to examination and tests in the mill, shop, and field.

3.6 ACCEPTANCE STANDARDS

A. Visual: The following indications are unacceptable:

1. Surface of welds shall be sufficiently free from coarse ripples, grooves, overlaps, abrupt ridges, and valleys.
2. Cracks
3. Undercut on surface that is greater than 1/32-inch deep.
4. Weld reinforcement greater than 5/32 inch.
5. Lack of fusion on surface.
6. Incomplete penetration (applies only when inside surface is readily accessible).
7. Convexity of fillet weld surface greater than 10 percent of longest leg plus 0.03 inch.
8. Concavity in groove welds.
9. Concavity in fillet welds greater than 1/16 inch.
10. Fillet weld size less than indicated or greater than 1-1/4 times the minimum indicated fillet leg length.

B. Magnetic Particle Examination: The following relevant indications are unacceptable:

1. Any cracks and linear indications.
2. Rounded indications with dimensions greater than 3/16 inch.
3. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.
4. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6y inches with the area taken in the most unfavorable location relative to the indications being evaluated.

C. Liquid Penetrant Examination: Indications whose major dimensions are greater than 1/16 inch shall be considered relevant. The following relevant indications are unacceptable:

1. Any cracks or linear indications.
2. Rounded indications with dimensions greater than 3/16 inch.
3. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.
4. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

D. Radiography: Welds that are shown by radiography to have any of the following discontinuities are unacceptable:

1. Porosity in excess of that shown as acceptable in the ASME-01, Appendix A-250.
2. Any type of crack or zone of incomplete fusion or penetration.

3. Any other elongated indication which has a length greater than:
   a. 1/4 inch for t up to 3/4 inch inclusive, where t is the thickness of the thinner portion of the weld.

b. 1/3 t for t from 3/4 inch to 2-1/4 inch, inclusive.
c. 3/4 inch for t over 2-1/4 inch.

4. Any group of indications in line that have an aggregate length greater than t in a length of 12t, except where the distance between the successive indications exceeds 6L where L is the longest indication in the group.

5. Where t pertains to the thickness of the weld being examined; if a weld joins two members having different thickness at the weld, t is the thinner of these two thicknesses.

E. Ultrasonic Examination: Linear-type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

1. 1/4 inch for t up to 3/4 inch.
2. 1/3 inch for t from 3/4 to 2-1/4 inch.
3. 3/4 inch for t over 2-1/4 inch.
4. Where t is the thickness of the weld being examined; if the weld joints two members having different thicknesses at the weld, t is the thinner of these two thicknesses. Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of length.

F. The University reserves the right to perform any in-process inspection to ensure that the welds meet the requirements of ASME B31.1 or ASME B31.9, as applicable.

3.7 CORRECTIONS AND REPAIRS

A. Defects shall be removed and repaired as specified in ASME B31.1 or ASME B31.9, as applicable, unless otherwise specified. Disqualifying defects discovered between weld passes shall be repaired before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface, eliminating sharp notches, crevices or corners. After defect removal is complete and before rewelding, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

END OF SECTION 23 0511

SECTION 23 0513 –MOTORS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes basic requirements for factory or field-installed motors.

B. The standards for the motors listed below exceed those commonly found in the commercial HVAC market. This is intentional and shall not be deviated from. Typical campus applications require much longer life in service than typical commercial applications. Many of the applications are 24 hour per day and on variable frequency drives. The various characteristics of high end industrial motors ensure a very long life in campus service and provide significantly increased energy performance. Their rugged construction helps ensure that initial efficiency is maintained over the life of the motor. Improved characteristics such as reduced shaft runout, and foot flatness allow for better alignment between the motor and the driven equipment. This improves efficiency and reduces noise and vibration. C. Related Sections include the following:

1. Division 23 Section "Vibration and Seismic Controls for HVAC" for mounting motors and vibration isolation and seismic-control devices.
2. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.2 QUALITY ASSURANCE

A. Source Limitations: If one of the approved manufacturers cannot be provided and factory installed, then a field-installed motors meeting these specifications shall be field installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in California Electrical Code (CEC), Article 100, by a testing agency acceptable to the University, and marked for intended use.

C. Motor Insulation: Insulation shall be inverter-rated Class F, or H, meeting NEMA Table 12-12, Part 31 for inverter duty service with VFD applications. Motor temperature rise shall be kept equal to or below class B standards when operating at full load on sine wave power. The assembled motor insulation system shall resist 2000-volt transients without premature motor failure.

D. Motors shall comply with NEMA MG 1 unless otherwise indicated.

E. Bearings: Bearing loads and bearing life shall be determined using AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings, and AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:
   a. Magnetic controllers.
   b. Reduced-voltage controllers.
   c. Variable frequency drives.
2. Designed and labeled for use with variable frequency controllers (VFD), and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 MOTOR REQUIREMENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in this section:

2.3 MOTOR CHARACTERISTICS

A. Motors One Horsepower and Larger: Three-phase.

B. Motors Three-Quarter Horsepower and Smaller: Three-phase or Single-phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected. Polyphase-motor installations on less than 460-Volt nominal circuits shall require written permission from University’s Representative.

E. Service Factor: 1.15 or more for all motors on sine wave power; 1.0 for motors on inverter power.

F. Duty: "Severe Duty" and "Continuous Duty" at ambient temperature of 105 deg F (40 deg C) and at altitude of 200 feet above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Totally Enclosed Fan Cooled (TEFC); or Totally Enclosed Air Over (special applications only), or Totally Enclosed Not Ventilated (special applications only). Open Drip Proof Motors shall not be used.

2.4 POLYPHASE MOTORS ONE-HALF AND THREE-FOURTH HORSEPOWER

A. Efficiency: Meeting or exceeding EPACT 1992 requirements.

B. Bearings: Sealed

C. Service Factor: 1.25

D. Use: Minimize use of motors in this size range by combining loads.

2.5 POLYPHASE MOTORS ONE HORSEPOWER AND LARGER

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a Baldor Super E
b Marathon Blue Chip XRI
c Reliance XEX
d Siemens GP100A
e Toshiba EQPIII

B. Description: NEMA MG 1, Design B, medium induction motor.

a Efficiency: Meet or exceed the most stringent of the applicable Energy Code, NEMA Premium efficiency standards, as defined in NEMA MG 1 or the efficiencies listed below when tested in accordance with IEEE Standard 112, Method B procedures as stated in NEMA MG 1-12.53a.

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0

1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7

C. Retain first paragraph below for service factors exceeding NEMA standard for other than open-dripproof motors. If retaining, coordinate with Drawings or other Sections. See "Product Characteristics" Article in the Evaluations for discussion of service factor. A service factor of at least 1.15 is available for most motors, including explosion proof; however, there are exceptions.

D. Service Factor: 1.15.

E. Retain one of first two paragraphs below. Retain first paragraph for lower first cost. Retain second to require all multispeed motors to be two-winding type. See "Multispeed and Variable-Speed Considerations" Article in the Evaluations.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Class B.

I. Insulation: Class F.

J. Code Letter Designation:

a Motors 15 HP and Larger: NEMA starting Code F or Code G.
b Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

L. Warranty: 36 months

M. All motors 40 HP and greater shall be provided with motor mounted power factor correction capacitors to improve power factor to .90 minimum. Motors less than 40 HP shall be provided with .85 power factor. Where motors less than 40 HP are not available with minimum .85 power factor, provide motor mounted power factor correction capacitor to improve power factor to at least .90 under rated load condition.

2.6 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.
2. Temperature Rise: Matched to rating for Class B insulation.
3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Motors connected to variable frequency controllers shall have shaft grounding devices meeting the following requirements:

1. Manufacturer: AEGIS SGR™ Bearing Protection Rings manufactured by Electro Static Technology (EST).
2. Shaft grounding shall be a bearing isolator, or labyrinth seal, that includes a built-in grounding ring and brush. The brush shall contain conductive microfibers that completely surround the shaft to discharge any current flowing through it.
3. Motors less than 100 HP size shall be provided with a single shaft grounding ring provided on the drive end of the motor.
4. Motors 100 HP size and larger shall be provided with a shaft grounding ring on both ends of the motor shaft or shall have an insulated ceramic bearing installed on the non-drive end of the motor and a shaft grounding ring installed on the drive end of the motor.
5. Apply a fast drying silver paint on the shaft surface to prevent corrosion.
6. Shaft grounding ring wear shall be less than 0.001” in 10,000 hours with a fiber wear length designed for expected life 200,000+ hours based on testing. Shaft grounding rings shall be compatible with operating environments ranging from -40° F (-40° C) to 300° F (150° C) and 0-90% RH (non-condensing).

D. Cooling Tower Motors: provide with tropicalization (protective coating) treatment performed.

2.7 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align motor with base.

B. Comply with mounting and anchoring requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC."

C. Connect motor leads to power source using rings and bolts or split bolts as needed. Insulation of connected motor leads shall be of the highest quality and designed to withstand the same temperature as the internal windings. Ordinary electrical tape is not generally suitable for this service and shall not be used as the only means of insulation. Wire nuts shall not be used. D. Motor power leads shall be marked at the source and at the connection box on the motor.

3.3 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
2. Test interlocks and control features for proper operation.
3. Verify that current in each phase is within nameplate rating.

B. Testing: University's Representative may engage a qualified testing agency to perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspections stated in NETA ATS, Section 7.15.1 and certify compliance with test parameters.

C. After the University's testing agency is finished, correct any malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and the University shall retest.

3.4 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.5 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 23 0513

SECTION 23 0516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following pipe expansion joints and expansion compensation devices for mechanical piping systems:

1. Pipe bends and loops.
2. Alignment guides and anchors.

B. Related Sections include the following:

1. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

1.2 DEFINITIONS

A. BR: Butyl rubber.

B. Buna-N: Nitrile rubber.

C. CR: Chlorosulfonated polyethylene synthetic rubber.

D. CSM: Chlorosulfonyl-polyethylene rubber.

E. EPDM: Ethylene-propylene-diene terpolymer rubber.

F. NR: Natural rubber.

G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

A. Product Data: For each type of pipe expansion joint and alignment guide indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.

2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, and location for each expansion joint.

C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer per the manufactures data submitted.

D. Welding certificates.

E. Operation and Maintenance Data: For pipe expansion joints to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

B. Seismic Engineering: Seismic bracing and support design, mounting hardware and equipment, support systems, restraint systems, anchorage systems, and installation shall conform to the CBC requirements for Seismic Zone 4. Submit calculations, plans, and documents stamped by a qualified California registered engineer.

C. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage support loads, and vertical loads applied to building structures and structural components shall be reviewed, analyzed, and subject to approval by the project structural engineer of record.

D. Flexible pipe connectors and expansion joints shall be rated for 150% of design maximum working pressure, or as recommended by the product Manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

a.

2.2 ALIGNMENT GUIDES

A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

1. Manufacturers:

a. Adsco Manufacturing, LLC.
b. Ebba Iron Sales
c. Flexicraft Industries.
d. Hyspan Precision Products, Inc.
e. Metraflex, Inc.
f. Or equal.

2.4 MATERIALS FOR ANCHORS

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Imbedded strut inserts:

C. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

D. Washers: ASTM F 844, steel, plain, flat washers.

E. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.

1. Stud: Threaded, zinc-coated carbon steel.
2. Expansion Plug: Zinc-coated steel.
3. Washer and Nut: Zinc-coated steel.

F. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened Portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
3. Washer and Nut: Zinc-coated steel.

G. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 03 Section "Cast-inPlace Concrete" for formwork, reinforcement, and concrete.

H. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPE BEND AND LOOP INSTALLATION

A. Attach pipe bends and loops to anchors.

1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

B. Pipe bends and loops for high pressure steam system shall be of one continuous piece of pipe, welded at each end.

3.4 ALIGNMENT-GUIDE INSTALLATION

A. Install guides on piping adjoining pipe expansion joints and bends and loops.

B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

3.6 SEISMIC JOINTS

A. Install Seismic Joints according to the requirements of CBC Seismic Zone 4, and Project Geotechnical Reports.

B. Install seismic joints of sizes matching size of pipe in which they are installed.

C. Seismic joints shall be flexible stainless steel hose type, or double ball joint type.

D. Provide shut-off valve on main pipe side of seismic joint installations to isolate failed joints, allowing the system(s) to stay in service. E. Install seismic joints in all piping.

F. Ensure maintenance accessibility of seismic joints.

3.7 ROOFTOP AND OUTDOOR APPLICATIONS

A. Outdoor assemblies shall be fully weather-proof design and installation, with appropriate materials, and material coatings. Mounting hardware such as bolts, nuts, washers, anchors straps, brackets, fastening hardware etc., shall be stainless steel or HDG finished.

END OF SECTION 23 0516

SECTION 23 0519 - METERS AND GAGES FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following meters and gages for mechanical systems:

1. Thermometers.
2. Thermowells.
3. Gages.
4. Test plugs.
5. Flowmeters.
6. Thermal-energy meters.

B. Related Sections include the following:

1. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.
2. Division 23 Section "Hydronic Piping and Valves" for hydronic system meters inside the building.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers, gages, flowmeters and thermal-energy meters indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer, gage, flowmeter and thermal-energy meter, signed by product manufacturer.

D. Operation and Maintenance Data: For flowmeters, and thermal-energy meters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 LIQUIED IN GLASS THERMOMETERS

A. Manufacturers

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
7. Or equal.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers: Standard: ASME B40.200.

1. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
2. Case Form: Adjustable angle unless otherwise indicated.
3. Tube: Glass with magnifying lens and blue organic liquid.
4. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
5. Window: Ultraviolet Protective Acrylic.
6. Stem: Aluminum, brass or stainless steel and of length to suit installation.
7. Design for Air-Duct Installation: With ventilated shroud.
8. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches- 18 UNEF -2A coupling nut
10. Accuracy: Plus or minus 1 percent of scale range or one scale division. RTD: plus or minus 0.6% of scale range.

2.3 THERMOWELLS

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
6. Or equal.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

C. Characteristics:

1. Threaded Brass.
2. Pressure Rating: Not less than piping system design pressure.
3. Stem Length: Extend 2" into fluid or to extend to center of pipe.
4. Extension for Insulated Piping: 2 inches nominal but not less than thickness of insulation.
5. Threaded Cap Nut: With chain permanently fastened to well and cap.

2.4 PRESSURE GAGES

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Or equal.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: 4-1/2-inch diameter, cast aluminum, black finished, stem-mounted flangeless.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass tube and socket.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial Face: Aluminum, white background with black graduations and markings.
6. Pointer: Adjustable black finish.
7. Window: Clear glass.
8. Ring: Friction type, 304 stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of full scale.
10. Range for Fluids under Pressure: Two times operating pressure.
11. Scale: Scale shall be psig.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel threaded ball type valve.
2. Syphons: NPS 1/4 coil of brass tubing or stainless steel with threaded ends.
3. Snubbers: ASME B40.100, NPS 1/4 brass bushing with corrosion-resistant, porous metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

A. Manufacturers:

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. Or equal.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem beyond insulation for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing neoprene, valves gasketed orifice, suitable for inserting a 1/8" OD probe assembly.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

2.6 FLOWMETERS

A. Manufacturers:

1. Foxboro 84 Series.
2. Rosemount 8800CA.
3. Moore Products.
4. Endress + Hauser, Prowirl 77.
5. Or equal.

B. Vortex Type:

1. Description: Inline vortex type for installing between pipe flanges and measuring flow directly in gallons per minute.
2. Construction: Stainless-steel body; with integral transmitter and direct-reading scale, and class 150 lb ANSI B16.5 flanges for chilled water.
3. Pressure Rating: 150 psig for chilled water.
4. Temperature Rating: 40 deg F for chilled water.
5. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons. Provide in remote wall mounted NEMA 4x enclosure.
6. Integral Transformer: For low-voltage power operation.
7. Accuracy: Plus or minus 0.25 percent for liquids.
8. Provide with isolation valve to allow the flow sensor to be removed without interrupting the flow in the pipe.
9. Provide flow meter with Hart Communication Protocol. Meters shall have output of 4-20 ma for Campus automation and include totalizer.
10. Provide matched pair of temperature sensors and transmitters, 100-ohm platinum RTD in stainless steel wells for connection to the building automation system and calculate total Btu used.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install bimetallic-actuated dial thermometers in the following locations:

1. Inlet and outlet of each hydronic steam generator.
2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
3. Inlet and outlet of each hydronic heat exchanger.

4. Inlet and outlet duct of each air handling unit.

B. Install bimetallic-actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:

1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
3. Process Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
4. Steam and Condensate: 50 to 400 deg F, with 5-degree scale divisions.
5. Air Ducts: 40 to 120 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages at chilled-water and at all process chilled water heat exchangers. .

B. Install dry-case-type pressure gages at suction and discharge of each pump.

C. Provide the following pressure ranges for the gages or industry standard for pressure per manufacturer's recommendation:

1. Heating Hot Water Piping: 0 to 100 psi.
2. Chilled Water Piping: 0 to 100 psi.
3. Process Chilled Water Piping: 0 to 100 psi.
4. Steam Piping: 0 to 200 psi.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending a minimum of 2 inches into fluid or to the center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install remote-mounting pressure gages on panel. Provide root valve at the main piping and needle valve at the remote panel.

F. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).

G. Install gate valve and syphon fitting in piping for each pressure gage for steam.

H. Install test plugs in piping.

I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

J. Install flow meter elements in accessible positions in piping systems.

K. Install flow meter with the minimum length of straight piping as recommended by the manufacturer to meet manufacturer guarantee performance where possible.

L. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

M. Install permanent indicators on walls or brackets in accessible and readable positions.

N. Install connection fittings for attachment to portable indicators in accessible locations.

O. Install flow meters in chilled water return piping leaving the building.

P. Assemble components and install flow meters.

Q. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems." Work shall be performed by the electrical sub-contractor.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Work shall be performed by the electrical sub-contractor.

3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.6 CLEANING

A. Clean windows of meters, and gages, and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer’s touch-up paint.

END OF SECTION 23 0519

SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following hangers and supports for mechanical system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment support.
2. Division 23 Section "Common Work Results for HVAC" for metal supports, anchorages, and material and coating requirements for rooftop and outdoor applications.
3. Division 23 Section "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports shop drawing for piping and equipment in accordance with CBC for seismic zone 4.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Pipe positioning systems.

B. Shop Drawings: Signed and sealed by a qualified California registered professional engineer. Show fabrication and installation details and include calculations for the following:

4. Trapeze pipe hangers. Include Product Data for components.
5. Metal framing systems. Include Product Data for components.
6. Pipe stands. Include Product Data for components.
7. Equipment supports. C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel." 5. ASME Boiler and Pressure Vessel Code: Section IX.

B. Seismic Engineering: Seismic bracing and support design, mounting hardware and equipment, support systems, restraint systems, anchorage systems, and installation shall conform to the CBC requirements for Seismic Zone 4. Submit calculations, plans, and documents stamped by a qualified California registered engineer.

C. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage and support loads, and vertical loads applied to building structures and structural components shall be reviewed, analyzed, and approved by the project structural engineer of record.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.
3. Grinnell Corp.
4. Tolco Inc.
5. Superstrut.
6. PHD
7. Or equal.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. Power-Strut Div.; Tyco International, Ltd.
4. Tolco Inc.
5. Unistrut Corp.; Tyco International, Ltd.
6. PHD
7. Or equal.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Pipe Shields, Inc.
2. ACME Construction
3. Bayside Insulation
4. PHD
5. Shaw – Piping Technology & Product
6. Clement
7. Or equal

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature or per manufacturer’s submittal.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Shall not be used unless approved by the University’s Representative and only for special situations. Gas driven fasteners or Ramset © might be utilized.

B. Mechanical-Expansion Anchors or: Insert-wedge-type zinc-coated, except exterior or corrosive environments shall be stainless steel, for use in hardened portland cement concrete with pullout, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Hilti, Inc.
c. ITW Ramset/Red Head.
d. Powers
e. Simpson Strong-Tie Company.

f. Or equal.

C. Concrete Inserts: Carbon steel, electro-galvanized, except exterior or corrosive environments shall be stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. UL listed for use in metal deck formed concrete and formed slabs for pre-positioning and attaching hanger rods in poured concrete decks. Suitable for seismic loads and brace attachments.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. ISAT (Blue Banger Hanger).

c. Simpson Strong-Tie Company (Blue Banger Hanger).
d. Tolco.
e. PHD
f. Or equal.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Durablock
d. PHD
e. Or equal.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:

a. MIRO Industries.
b. Durablock
c. PHD
d. Or equal.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. Durablock
c. MIRO Industries.
d. Portable Pipe Hangers.
e. Or equal.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers:

a. Portable Pipe Hangers.
b. Durablock
c. Miro Industries
d. Or equal.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

G. Pipe Stands in Exterior Below Grade Vaults: Shop or field fabricated supports shall be electro-galvanized steel or stainless steel.

1. Manufacturers:
a. PPH
b. Or equal.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish design for exterior use.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated on support details and drawings and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Clevis Hangers: For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation every 25 ft.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off center closure for hanger installation before pipe erection.
6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange for steam and condensate only.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur for steam and condensate only.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur for steam and condensate only.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary for steam and condensate only.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary for steam and condensate only.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction for steam and condensate only.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape. Provide with retaining bracket.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel Ibeams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel Ibeams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of wooden beams only.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated on the support details and drawings and except as specified in piping system Sections, install the following types:

1. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
2. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
3. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchor attachments if concrete insert is not available in concrete construction.

O. HANGER AND SUPPORT INSTALLATION

P. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

Q. Flexible connection located in horizontal piping shall be supported within 2 feet of each connector.

R. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

S. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

T. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping. Ok to encapsulate HHW.

U. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. V. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

W. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

X. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

Y. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

Z. Install lateral bracing with pipe hangers and supports to prevent swaying.

AA. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

BB. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

CC. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

DD. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4.Shield Dimensions for Pipe: Per manufacturer's recommendation.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

7. Shields and inserts may be trimmed in the field to accommodate fittings and accessories.

EE. Hangers shall not be in direct contact with the pipe. Non-metallic coatings may be used for electrolytic protection where hangers are in direct contact with copper piping.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 ROOFTOP AND OUTDOOR APPLICATIONS

A. Outdoor assemblies shall be fully weather-proof design and installation. Mounting hardware such as bolts, nuts, washers, anchors straps, brackets, fastening hardware etc., shall be stainless steel or designed for exterior use.

B. Mounting hardware in below grade exterior vaults shall be electro-galvanized steel or stainless steel.

END OF SECTION 23 0529

SECTION 23 0548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Elastomeric isolation pads and mounts.
2. Restrained elastomeric isolation mounts.
3. Restrained spring isolators.
4. Housed spring mounts.
5. Elastomeric hangers.
6. Spring hangers.
7. Spring hangers with vertical-limit stops.
8. Thrust limits.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Restrained vibration isolation roof-curb rails.
12. Seismic snubbers.
13. Restraining cables.
14. Steel and inertia, vibration isolation equipment bases.

B. Related Sections include the following:

1. Division 23 Section “Expansion Fittings and Loops for HVAC Piping” for flexible piping connectors.

1.2 DEFINITIONS

A. Z: seismic zone factor.

1.3 PERFORMANCE REQUIREMENTS

A. Conformance with the California Building Code seismic restraint requirements for seismic zone-4.

B. Z: 0.40

C. Component Seismic Coefficient: shall be per CBC Table 16-Q and the soil profile type for the site.

D. Seismic Importance Factor: 1.5 for anchorage of machinery and equipment required for lifesafety systems, 1.0 for other equipment. Life-safety systems would include air-handling units and exhaust fans serving stairwell pressurization fans or laboratories.

E. Component Response Modification Factor: shall be per CBC Table 16-O for the respective nonstructural components and equipment.

F. Component Amplification Factor: Shall be per CBC Table 16-O for the respective nonstructural components and equipment.

G. Sound and Vibration Performance: The Design-Build Team shall retain a licensed professional acoustical engineer for acoustic and vibration analysis and design. All systems shall be reviewed by the acoustical engineer for compliance with acoustics and vibration control contract document requirements. Provide acoustic and vibration design solutions, including system modifications, equipment modifications, additional sound treatment devices, all materials and devices, and all labor per the acoustical engineer's design solution reports, and recommendations.

H. All rotating and reciprocating equipment shall be statically and dynamically balanced to meet the following vibration limits under all design operating conditions and under specified vibration isolation:

Equipment Type	Vibration Limit (inches/sec, RMS)
Pumps	0.1
Direct Drive Fans	0.05
Belt-Driven Fans	0.1
Reciprocating Equipment	0.4
All Other Equipment	0.1

1. These vibration limits apply either on the bearings or the equipment support structure, whichever applicable.
2. The vibration limits shall include the effects of inertia mass or inertia bases, where applicable.
3. Equipment with variable frequency drives shall meet these limits throughout the entire frequency range that the equipment will operate.

I. Vibration Isolated Equipment with Variable Frequency Drives (VFD) shall not be operated below the following rotational speeds:

Specified Isolation Minimum Static Deflection	Minimum Allowed Equipment Rotational Speed (rpm)
Less than 1 inch	600
1 inch	500
2 inches	400
3 inches	350
4 inches	300
5 or more inches	250

1.4 SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.

1. Manufacturer's model number for each vibration isolator, the equipment or ductwork or pipeline to which it is to be attached, and the number of isolators to be furnished for each installed system.
2. For steel spring mounts or hangers - free height, deflected height, solid height, isolator loading, and diameter of spring coil.
3. For neoprene isolators - free height, deflected height, and isolator loading.
4. An itemized list of all isolated equipment with detailed schedules showing isolators proposed for each piece of equipment, referencing materials and drawings.

B. Shop Drawings: Signed and sealed by a qualified California registered professional engineer. Include the following:

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

    a. Show base construction for equipment; include dimensions, structural member sizes and support point locations.
    b. Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.

4. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

    a. For seismic slack cables - indicated method to achieve vertical restraint.

5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
6. Layout Drawings showing locations and sizes of braces for suspended piping and ductwork.

C. Welding certificates.

D. Manufacturer’s Certification: Upon completion of installation, submit written certification from equipment manufacturer that vibration isolation and seismic control devices are installed correctly and properly adjusted.

1.5 QUALITY ASSURANCE

A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to CBC or shall bear anchorage preapproval "OPA" number, from OSHPD or another agency acceptable to University's Representative, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified California registered professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.

B. Seismic Engineering: Seismic bracing and support design, mounting hardware and equipment, support systems, restraint systems, anchorage systems, and installation shall conform to the CBC requirements for Seismic Zone 4. Submit calculations, plans, and documents stamped by a qualified California registered engineer.

C. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage and support loads, and vertical loads applied to building structures and structural components shall be reviewed, analyzed, and approved by the project structural engineer of record.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corp.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.
5. Or equal.
6. Caldine.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 VIBRATION ISOLATORS

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
2. Durometer Rating: 50 or 60.
3. Number of Layers: As required. Use multiple layers, separated by steel shims, depending on supported equipment load. See manufacturer's data for load capacities.
4. Based on Mason SWM.

B. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Durometer Rating: 50 or 60.
2. Based on Mason ND.

C. Restrained Elastomeric Mounts: All-directional elastomeric mountings with seismic restraint.

1. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to AASHTO M251, the standard for bridge-bearing neoprene.
3. Based on Mason BR.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
7. Based on Mason SLF (or) SLFH.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Based on Mason SLR (or) SLRS.

F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
4. Based on Mason SSLFH.

G. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Colorcode or otherwise identify to indicate capacity range.

1. Based on Mason HD.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene, two elements. Steel washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Based on Mason 30N.

I. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene, two elements.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

8. Based on Mason PC30N.

J. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
8. Based on Mason WBI (or) WBD.

K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

1. Based on Mason ADA (or) ADAH.

L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2inch- thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

1. Based on Mason VSG (or) VSGH.

2.4 SEISMIC-RESTRAINT DEVICES

A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 60, plus or minus 5, with a flat washer face.

1. Based on Mason HG.

B. Seismic Snubbers: All directional and factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 60, plus or minus 5.
3. Snubbers, and snubber quantities, shall be selected based upon calculation of forces/loads.

4. Based on Mason Z-1225, or Z-1011.

C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

1. Based on Mason SCB/SCBH.

D. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.5 VIBRATION ISOLATION EQUIPMENT BASES.

A. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment. Beam deflection shall not exceed 0.10 inches over entire length.
3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Motor Mounts: Slide rails.
5. Based on Mason M, or WF.

B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.
5. Motor Mounts: Slide rails.
6. Based on Mason BMK, or KSL.

2.6 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be electrogalvanized. Exception: Hot-dip galvanized metal components for exterior use or within tunnels, trenches or mechanical rooms containing high temperature water or steam systems.
3. Nuts, bolts, and washers for outdoor use or wet applications shall be stainless steel.
4. Baked enamel for metal components on isolators for interior use.
5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."

B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

C. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure. Seismic snubbers shall be as follows:

1. Equipment weighing less than 2400 pounds – Snubber shall be based on Mason Z-1225.
2. Equipment weighing greater than 2400 pounds – Snubber shall be based on Mason Z1011.
3. Snubbers, and snubber quantities, shall be selected based upon calculation of forces/loads.

D. Install restrains per detail provided by Seismic Engineer if no detail is provided, install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

E. Install per seismic manufacturer, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze as indicated on the detailed drawings. Requirements apply equally to hanging equipment. Do not weld angles to rods.

F. Install resilient bolt isolation washers on equipment anchor bolts.

G. Seismic restraint systems shall be installed in strict accordance with the manufacturer's seismic restraint guidelines manual and all certified submittal data. H. Branch lines may not be used to restrain main lines.

I. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent piping.

J. Do not brace a system to two independent structures such as ceiling and wall.

K. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

L. Installation of seismic restraints shall not cause any change in position of equipment or piping, resulting in stresses or misalignment.

M. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.

N. Additional Seismic devices, mounts, and equipment bases shall be installed, type of device shall be selected by licensed structural engineer, or licensed acoustical engineer as required to meet project requirements.

O. Ductwork shall be installed with vibration isolation devices required to meet sound criteria.

P. Provide seismic joints in piping and ductwork crossing building seismic joints.

3.3 ACOUSTICAL SLEEVES

A. For interior pipe penetrations through STC 50 acoustical walls or above, provide acoustical caulking. Max ½" annular space.

B. Where piping or ductwork passes through Exterior walls or floors provide a split acoustical seal with minimum ¾ inch closed cell neoprene sponge bonded to the inner faces.

C. Once the pipe or duct is inserted through the seal, the seal shall be tightened to eliminate clearance between the inner sponge face and the penetrating element. Link Seal above or below grade

D. Concrete shall be packed around the seal to make it integral with the floor, wall or ceiling if such sleeve is not already in place around the pipe prior to the construction of the building member.

E. Where temperatures exceed 240ºF., 10 lb. density fiberglass shall be used in lieu of the sponge.

F. Coordinate entire installation with requirements of insulation and fire-stopping methods.

G. Seal shall be Mason Type SWS, Mason Type SPS, or equal.

3.4 PIPING ISOLATION:

A. Pipe support isolation shall comply with the following general guidelines:

1. Specified Extent of Isolation: Piping, 2 inches in diameter or greater, which is connected to vibration isolated equipment shall be isolated from the building structure (defined as any rigid building elements, such as normal structure; walls, whether load-bearing or not; and any other rigid components attached to the structure) using resilient supports, pipe guides, and penetration sleeves (as applicable) for a distance of 25 feet.
2. Spring isolators shall be selected for a static deflection, under load, of not less than 1 inch (25 mm). Type FSN or HS isolators (whichever is applicable to the mounting condition) shall be used.
3. Where lateral support of pipe risers is required within the specified limits of isolation, this shall be accomplished by use of Type FSN, or resilient lateral supports with the specified minimum static deflection.
4. Pipes that penetrate the building structure within the specified extent of isolation shall be isolated from the structure by use of resilient penetration sleeves and seals.
5. Drain piping connected to vibration-isolated equipment shall not rigidly contact the building structure or other non-isolated system.
6. Piping connected to vibration-isolated equipment shall be installed so that it does not strain or force out of alignment pipe flexes or vibration isolators supporting either the equipment or the piping.
7. Where pipes are racked together, the most stringent isolation requirement, as defined in this Section shall take precedence.
8. Passive Mechanical Equipment: Passive mechanical equipment refers to equipment without motors such as cooling coils, heat exchangers, etc. For passive mechanical equipment connected to vibration-isolated mechanical equipment by piping of length less than 25 feet):

a. Provide vibration isolation flexible pipe connections at passive equipment.

b. Support pipe connections between mechanical and passive equipment on hanger with the same type and deflection as the mechanical equipment support.

9. Unless otherwise required in this Section, gas, gravity drain, and fire protection piping are exempt from vibration isolation requirements.

3.5 SHEET METAL DUCT ISOLATION:

A. The following general guidelines shall be followed:

1. Specified Extent of Isolation: Intake ducts and discharge ducts from all fans or fan units (isolated or not) greater than 10 HP (7.5 KW) shall be isolated from the building structure (defined as any rigid building elements, such as normal structure; walls, whether load-bearing or not; and any other rigid components attached to the structure) using resilient supports, guides, and penetration sleeves (as applicable) for a distance of 25 feet.

2. Ductwork isolation requirements are based on duct equivalent diameters. For rectangular ductwork, the equivalent diameter is the diameter of duct having the same cross-sectional area.

3. Spring isolators shall be selected for a static deflection, under load, of not less than 1 inch (25 mm). Type FSN or HS isolators (whichever is applicable to the mounting condition) shall be used.

4. Type FSN spring supports or resilient lateral guides of the specified minimum static deflection shall be used whenever lateral support of vertical duct runs is required within the limits for isolation specified above.

5. Ductwork that penetrates the building structure within the limits of isolation specified below shall be isolated from the structure by use of resilient penetration sleeves and seals.

3.6 EQUIPMENT ISOLATION

A. Install duct, piping and electrical flexible connections to externally vibration-isolated equipment.

B. Flexible duct connections shall result in a loose and resilient connection and maintain a minimum clearance of 4” between the two sides that they connect.

C. Flexible connectors shall be used to connect all piping to isolated equipment, except equipment for which flexible connectors are not permitted by code.

D. Flexible pipe equipment connectors for all isolated equipment shall be as follows:

1. Spherical rubber expansion joints.
2. Flexible hose joints.
3. Double-ply stainless steel bellows without braided jackets.
4. Stainless steel corrugated hose, stainless steel sheath, with metal connectors with minimum specified live lengths. Hose type flexible connectors shall have minimum live lengths as specified in the 1999 ASHRAE Handbook, Table 46 (see below).

5. Locate isolation device downstream of shut-off valves.

Nominal Diameter (inches)	Minimum Live Length (inches)
0.75	12
1	12
1.5	12
2	12
2.5	12
3	18
4	18
5	24
6	24
8	24
10	24

E. Equipment Isolators: For equipment larger than 0.5 horsepower, use spring isolation device. For equipment smaller than 0.5 horsepower, use neoprene isolation device.

F. Install flex connections in parallel with motor shaft.

H. Equipment Isolation Schedule:

MARK	Motor Hp	Equipment RPM	VFD	Inertia Base Type	Isolator Type	Hot-Dip galva-nized	Static Deflec-tion (inches)	Comments
AHU	--	--	--	--	--	--	--	External Isolation for en-tire AHU not required
AHU Supply Fans	--	--	Yes	Mason M	Mason SLF	--	2	Internal fan isolation; di-rect drive fans
AHU Return Fans	--	--	Yes	Mason M	Mason SLF	--	2	Internal fan isolation; di-rect drive fans
AHU	--	--	--	Mason WF	Mason WFSLR SLF	--	3	External Isolation for en-tire AHU

MARK	Motor Hp	Equipment RPM	VFD	Inertia Base Type	Isolator Type	Hot-Dip galva-nized	Static Deflec-tion (inches)	Comments
AHU	--	--	--		Mason RSC	Yes	3	External Isolation for en-tire AHU
Pump	--	--	Yes	Mason KSL	Mason SLF	Yes	1	Install on concrete inertia bases
Roof-Mounted Exhaust Fans	--	--	--	Mason KSL	Mason KSLSLF	Yes	2	Centrifugal fan – vent set
Refrigeration Condensing Units	--	--	--	Mason M	Mason SLF	Yes	1	Basement & Loading Dock
Floor-mounted Fan Coils	--	--	--	Mason M	Mason SLF	--	1	
Suspended Fan Coils	--	--	--	--	Mason PC30N	--	1	

3.7 EQUIPMENT BASES

A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.

1. Cast-in-place concrete materials and placement requirements are specified in Division 03.

B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic codes at Project site.

1. Install dowel rods to connect concrete base to concrete floor. Install dowel rods on 18inch centers around the full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.8 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. Isolator seismic-restraint clearance.
2. Isolator deflection.
3. Snubber minimum clearances.

3.9 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

D. Adjust active height of spring isolators.

E. Adjust snubbers according to manufacturer's written recommendations.

F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

G. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.10 CLEANING

A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION 23 0548

SECTION 23 0553 – IDENTIFICATION FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Access panel and door markers.
5. Pipe markers.
6. Duct markers.
7. Damper tags.
8. Stencils.
9. Valve tags.
10. Valve schedules/chart.
11. Warning tags.
12. Thermostats referencing terminal boxes.
13. Control devices and instruments

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Valve Numbering Scheme. Provide hard-copy and electronic spreadsheet of valve schedule covering all valve tags. Coordinate numbering scheme prior to submittal.

D. Valve Plans and Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) in maintenance manuals.

E. Air-Side Equipment Schedule: Provide hard copy and electronic spreadsheet of air-side equipment schedule covering damper, terminal boxes, instrumentation, etc. Coordinate numbering scheme prior to submittal.

F. System Drawings: For each piping system for each air system (exhaust included). Furnish system one-line plan drawings indicating valves, dampers, instruments, control devices, smoke detectors, and equipment addressed in this section. Furnish electronic spread sheets for each system. Coordinate numbering scheme prior to submittal.

G. Equipment Location Plans: For each system. Furnish plans showing equipment, equipment identification numbers/tags, and description.

1.3 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

B. NFPA Compliance: Comply with requirements of NFPA-99 for piping and equipment labeling and identification.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.

3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent epoxy adhesive or rivets.

1. Terminology: Match schedules as closely as possible.
2. Data:
    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, white surface, black phenolic core, with black melamine subcore. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: 1/8 inch.
4. Provide signs on equipment that is automatically started to comply with CAL-OSHA requirements.
5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise approved.
2. Lettering: Use piping system terms and abbreviations to meet ASME (ANSI) standard A13.1 as a recommended scheme for identification of pipe systems.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

C. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.4 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent epoxy adhesive. As an option, stencil may be used.

B. Automatic or Motorized Control Damper Tags: Same as valve tags.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Use for pipe marking, exterior, gloss, acrylic enamel black. Paint may be in pressurized spray-can form.
3. Identification Paint: Use for contrasting background, exterior, acrylic enamel in colors according to ASME A13.1.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2inch numbers, with numbering to meet ASME (ANSI) standard A13.1 as a recommended scheme for identification of pipe systems. Provide 5/32-inch hole for fastener.

1. Material: 19 Gage thick brass minimum 2” in diameter.
2. Valve-Tag Fasteners: Stainless steel chain, bronze chain or S-hook.

2.7 VALVE PLANS

A. Valve Plans: For each piping system, on standard-size or 11”x17” bond paper. Provide a plan per floor showing the location, valve number, control device number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Plan and Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve plan and schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

2.9 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Seton Identification Products.
3. R&R Identification Co.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering

for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Meters
    c. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
    d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    e. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    f. Fans, blowers, VAVs, venture valves, and mixing boxes.
    g. HVAC custom, central-station and zone-type air handling units.
    h. Tanks and pressure vessels.
    i. Humidifiers, water-treatment systems, and similar equipment.

C. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe or self-adhesive vinyl.
2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe or self-adhesive vinyl.
3. Do not use pipe markers and tapes for bare pipes conveying fluids at temperatures of 125 deg F or higher or self-adhesive vinyl.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. One per room, visible from floor level.
2. Flow directions shall be indicated on each system.
3. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
4. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.

5. At access doors, manholes, and similar access points that permit view of concealed piping.
6. Near major equipment items and other points of origination and termination.
7. Spaced at maximum intervals of 20 feet along each run. Located on each side of wall penetrations.

C. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

3.4 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive or stencil on air ducts in the following color codes:

1. Green: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
5. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (maximum intervals of 25 feet for exhaust ductwork) in each space where ducts are exposed or concealed by removable ceiling system.

D. Duct markers shall include air system type, and air system number.

3.5 VALVE-TAG INSTALLATION

A. Install tags on all valves (all types) and control devices in piping systems, except check valves; valves within factory-fabricated equipment and shutoff valves. List tagged valves in a valve schedule. Install tags on valves such that they will not interfere with the valve operation and maintenance.

B. Valve-Tag Application Schedule:

1. Information:

a. Service.
b. Floor.
c. Valve number.
d. Area served.
e. Normal position.
f. Duty.
g. Type (if not obvious).

2. Valve-Tag Size and Shape:
   a. 2 inches, round.

3.6 VALVE-PLAN INSTALLATION

A. Mount valve plan on wall in accessible location in each major equipment room.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 23 0553

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Air systems.
2. Hydronic piping systems.
3. Steam systems.
4. HVAC equipment quantitative-performance settings.
5. Laboratory fume hood airflow balancing.
6. Exhaust hood airflow balancing.
7. Space pressurization testing and adjusting.
8. Vibration measuring.
9. Sound level measuring.
10. Indoor-air quality measuring.
11. Verifying that automatic control devices are functioning properly.
12. Reporting results of activities and procedures specified in this Section.

B. Related Sections include the following:

1. Division 01 Section “General Commissioning Requirements” and Division 23 Section “Commissioning of HVAC”, for project commissioning requirements.

1.2 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated. E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

P. TAB: Testing, adjusting, and balancing.

Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

R. Test: A procedure to determine quantitative performance of systems or equipment.

S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.3 SUBMITTALS

A. Qualification Data: Within 45 days from Contractor's Notice to Proceed, submit 8 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Submit 8 copies of the 100% Construction Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days from Contractor's Notice to Proceed, submit 8 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Certified TAB Reports: Submit four copies of the preliminary reports prepared, as specified in this Section, on approved forms certified by TAB firm. Submit eight copies of the final report.

E. Warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB. Submit proof of a minimum of five years of experience in work similar to that required by the Project.

B. TAB Conference: Meet with University's Representative on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. The Construction Documents examination report.
c. TAB plan.
d. Work schedule and Project-site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.5 PROJECT CONDITIONS

A. Partial University Occupancy: The University may occupy completed areas of building before Substantial Completion. Cooperate with the University during TAB operations to minimize conflicts with University's operations.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Construction Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Construction Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify provision of balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify

that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation. B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine strainers for clean screens and proper perforations.

M. Examine three-way valves, if any installed, for proper installation for their intended function. of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine system pumps to ensure absence of entrained air in the suction piping.

P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in mixing boxes, and variableair-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

R. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and air-treating equipment. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from University's Representative before any adjustment of fan speed higher or lower than indicated speed. If a higher speed is needed, evaluate the system effects to determine and eliminate the cause of the increased resistance. System effect is a phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Increasing the fan speed shall not be the solution. If the University approves, make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
   Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance systems similar to constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.

3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.

6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.

6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

D. Balance or measurements of the high temperature water system is not required.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure pressure at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

B. Water balance systems at the University of California, Riverside campus is not necessary since the campus standard is to use Griswold Control Company’s automatic flow control valves with a variable flow pumping system and 2 way control valves.

C. Griswold Controls or equal automatic flow control valves are actuallyflow limiting devices, not automatic balancing valves. If the psid reading across the valve is between operating control range (i.e. 2-32 psid) than we are getting the correct flow. Include one psi to account for system aging and a safety factor. For a 2-32 psi valve a 3-psid is required, for 1-20 psi control range provide 2 psid, etc. Griswold has seven ranges available. The last number of the valve model denotes the lower limit of the control range. (e.g. model # 3522 means the valve should operate within a 2-32 PSID range.)

D. For air handling units with multiple coils, manual balancing valves shall be balanced. Adjust to provide design quantities. Use calibrated fitting and pressure gages to determine flow rates. Balance with automatic control valve fully open.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. The following procedure shall be used for a heating water system with a variable speed pump.

1. Verify that the manual shut-off valves are fully open.
2. Verify that the piping system is clear and that the strainers are clean.
3. Verify that each coil has a Griswold or equal automatic flow valve installed and the flow arrow is pointed in the correct direction. Each valve shall have two factory tags connected to it. One tag shall be permanently affixed to the valve body and the other shall be hung from the pressure taps so that it is visible outside the insulation. The tag shall have the name of the air handler or system served printed on it (e.g. BRENAH01, NSVAV037, HOBAH01C, etc.) Record each valve's tag information in the TAB report.
4. Override the controls to open the heating control valves to full flow. Griswold automatic flow control valves will limit flow to each coil to the maximum required coil rate (gpm). Valves are accurate to within ±5% over 95% of the pressure differential (PSID) control range.
5. Test is to determine the minimum differential pressure set point for the variable frequency drive (VFD). Turn the heating pump on and ramp it up to the speed needed to maintain the differential pressure 1 psi above the minimum control range at the Griswold valve with the highest-pressure drop requirement, normally the longest run. The differential it to be measured at the factory supplied taps on each valve. Griswold Controls market a variety of instruments for the purpose. In any case, the gages used shall be recently calibrated and accurate to + or – 0.1% of full scale. Select a gage that has a range appropriate for the system pressure. Recognize that the differentials measured are low and that a small error is actual reading can still add up to a large differential error. A direct reading differential gage calibrated in inches of water may be used.
6. Check the remaining Griswold valves to verify that they are within their control pressure range.
7. Record the differential pressure at the differential pressure transmitter that will be used as the input for the pump speed control. Verify that the transmitter is reading the same differential and that the VFD controlling the pump is receiving the correct signal either directly or from the Building Automation System. The pressure reading shall become the VFD set point and recorded in the TAB report.

B. Record final measurements for hydronic equipment performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for converters. Include entering and leaving dry bulb air temperatures (and wet bulb for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

3.10

3.11 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check the setting and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record the final setting.

D. Check the settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.12 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data. 1.

3.14 PROCEDURES FOR BOILERS

A. If hydronic, measure entering- and leaving-water temperatures and water flow.

B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.15 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.

5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Steam Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

3.16 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.17 PROCEDURES FOR LABORATORY FUME HOODS

A. Before performing laboratory fume hood testing, measure, adjust and record the supply airflow and airflow patterns of each supply air outlet that is located in the same room as the hood. Adjust the air outlet flow pattern to minimize turbulence and to achieve the desired airflow patterns at the face and inside the hood. Verify that adequate makeup air is available to achieve the indicated flow of the hood.

B. Fume Hood General Balancing Requirements:

1. Fume hoods shall be balanced with an inward flow, to a minimum of 100 feet per minute (fpm) face velocity across the opening, with a minimum of 70 fpm at any point.

2. Fume hoods equipped with automatic controls and occupancy sensors, shall be balanced for the controls system “unoccupied mode” (no employee working in the vicinity of the fume hood opening) to 60 fpm when all of the conditions of California Title 8 General Industrial Safety Order are met.

C. Measure, adjust, and record the airflow of each laboratory fume hood by duct Pitot-tube traverse with the laboratory fume hood sash in the design open position.

1. For laboratory fume hoods installed in variable exhaust systems, measure, adjust, and record the hood exhaust airflow at maximum and at minimum airflow conditions.
2. For laboratory fume hoods designed with integral makeup air, measure, adjust, and record the exhaust and makeup airflow.

D. For laboratory fume hoods that are connected to centralized exhaust systems using automatic dampers, adjust the damper controller to obtain the indicated exhaust airflow.

E. After balancing is complete, do the following:

1. Measure and record the static pressure at the hood duct connection with the hood operating at indicated airflow.
2. Measure and record the face velocity across the open sash face area. Measure the face velocity at each point in a grid pattern. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter of the opening.

    a. For laboratory fume hoods designed to maintain a constant face velocity at varying sash positions, also measure and record the face velocity at 50 and 25 percent of the design open sash position.
    b. Calculate and report the average face velocity by averaging all velocity measurements.
    c. Calculate and report the exhaust airflow by multiplying the calculated average face velocity by the sash open area. Compare this quantity with the exhaust airflow measured by duct Pitot-tube traverse. Report differences.
    d. If the average face velocity is less than the indicated face velocity, retest the average face velocity and adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity.
3. Check each laboratory fume hood for the capture and containment of smoke by using a hand-held emitting device. Observe the capture and containment of smoke flow pattern across the open face and inside the hood. Make adjustments necessary to achieve the desired results.

F. With the room and laboratory fume hoods operating at indicated conditions, perform an "as installed" performance test of the laboratory fume hood according to ASHRAE 110. Test each laboratory fume hood(s) and document the test results.

3.18 PROCEDURES FOR EXHAUST HOODS

A. Measure, adjust, and record the airflow of each exhaust hood. Measure airflow by duct Pitottube traverse. If a duct Pitot-tube traverse is not possible, explain why, in the report, and explain the test method used.

B. After balancing is complete, do the following:

1. Measure and record the static pressure at the hood exhaust-duct connection.
2. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to achieve optimum results.

3.19 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.

C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.

1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
3. Test room pressurization first, then zones, and finish with building pressurization.

D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.

E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.

1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test over pressurization and under pressurization, and observe and report on the system's ability to revert to the set point.
3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.

F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.

G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.22 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform building flush out for a 14 day period.

3.23 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.24 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: 0 to plus 10 percent.
2. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus l0 percent to plus l0 percent. Total room shall be ±10percent.
3. Heating-Water Flow Rate: +/- 5 percent.
4. Heating Hot Water Coils: ±5 percent.
5. Chilled-Water Flow Rate: +/- 5 percent.
6. Minimum Outside Air: 0 to 10 percent.
7. Air Terminal Units (Max): Minus 5 percent to plus l0 percent.
8. Exhaust Hoods/Cabinets: Minus 0 percent to plus l0 percent.
9. Chilled Water Pumps: Minus 0 percent to plus l0 percent.
10. Chilled Water Coils: Minus 5 percent to plus 5 percent.

3.25 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to

HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.26 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

C. Include a list of instruments used for procedures, along with proof of calibration.

D. Final Report Contents: In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

E. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.

13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

F. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

G. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.

2. Motor Data:

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.

f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Sound attenuator static-pressure differential in inches wg.
g. Preheat coil static-pressure differential in inches wg.
h. Cooling coil static-pressure differential in inches wg.
i. Heating coil static-pressure differential in inches wg.
j. Outside airflow in cfm.
k. Return airflow in cfm.
l. Outside-air damper position.
m. Return-air damper position.
n. Damper position(s). H. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.

n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

I. Gas- Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btuh.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btuh.
i. High-fire fuel input in Btuh.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btuh.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btuh.

J. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.

d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

K. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.
l. Duct mounted sound attenuator static-pressure differential in inches wg and velocity in fpm.

L. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.

b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

M. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

N. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.

e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

O. Boiler Test Reports:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Fuel type and input in Btuh.
g. Number of passes.
h. Ignition type.
i. Burner-control types.
j. Voltage at each connection.
k. Amperage for each phase.

2. Test Data (Indicated and Actual Values):

a. Operating pressure in psig.
b. Operating temperature in deg F.
c. Entering-water temperature in deg F.

d. Leaving-water temperature in deg F.
e. Number of safety valves and sizes in NPS.
f. Safety valve settings in psig.
g. High-limit setting in psig.
h. Operating-control setting.
i. High-fire set point.
j. Low-fire set point.
k. Voltage at each connection.
l. Amperage for each phase.
m. Draft fan voltage at each connection.
n. Draft fan amperage for each phase.
o. Manifold pressure in psig.

S. Vibration Measurement Reports:

1. Date and time of test.
2. Vibration meter manufacturer, model number, and serial number.
3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
4. Diagram of equipment showing the vibration measurement locations.
5. Measurement readings for each measurement location.
6. Calculate isolator efficiency using measurements taken.
7. Description of predominant vibration source.

T. Sound Measurement Reports: Record sound measurements on octave band and dBA test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both "background" and "HVAC system operating" readings. Record each tested location on a separate NC or RC chart. Record the following on the forms:

1. Date and time of test. Record each tested location on its own NC curve.
2. Sound meter manufacturer, model number, and serial number.
3. Space location within the building including floor level and room number.
4. Diagram or color photograph of the space showing the measurement location.
5. Time weighting of measurements, either fast or slow.
6. Description of the measured sound: steady, transient, or tonal.
7. Description of predominant sound source.

U. Indoor-Air Quality Measurement Reports for Each HVAC System:

1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

V. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.27 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Measure sound levels at two locations.
e. Measure space pressure of at least 10 percent of locations.
f. Verify that balancing devices are marked with final balance position.
g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by University's Representative.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of University's Representative.
3. University Representative shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, University shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.28 ADDITIONAL TESTS

A. Within 180 days of completing TAB, if requested by the University's Representative perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 0593

SECTION 23 0700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:

    a. Cellular glass.
    b. Flexible elastomeric.
    c. Mineral fiber.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

B. Related Sections:

1. Division 23 Section "Hydronic Distribution."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.
4. Division 23 Section "Hydronic Piping and Valves."

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

LEED Submittal:

1. Product Data for LEED-NC Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at pipe expansion joints for each type of insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail removable insulation at piping specialties, equipment connections, and access panels.
5. Detail application of field-applied jackets.
6. Detail application at linkages of control devices.
7. Detail field application for each equipment type.

D. Qualification Data: For qualified Installer.

E. Field quality-control reports if requested by the University's Representative.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by University's Representative. Use materials indicated for the completed Work.

1. Piping Mockups:

a. One each of a chilled water 90-degree threaded, welded, and flanged elbow.
b. One NPS 2-1/2 or larger valve.
c. One chilled water drain and strainer with removable portion of insulation.
d. One chilled water pressure temperature tap.
e. One chilled water mechanical coupling.

2. Ductwork Mockups:

a. Before installing special or alternate insulation, build mockups for each type of insulation and finish to demonstrate quality of insulation application and finishes. Build mockups using same materials as for the completed Work.

3. Equipment Mockups:

a. One in place chilled-water pump, if applicable to the project.
b. One in place tank or vessel, if applicable to the project.

4. For each mockup, fabricate removable sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
5. Notify University's Representative seven days in advance of dates and times when mockups will be constructed.
6. Obtain University's Representative's approval of mockups before starting insulation application.
7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless University's Representative specifically approves such deviations in writing.
8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
9. Demolish and remove mockups when directed.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Definition of "Or Equal": Where products are specified by manufacturers' name and accompanied by the term "or equal", comply with provisions in Division 01 Section "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "FactoryApplied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Cell-U-Foam Corporation; Ultra-CUF.
    b. Pittsburgh Corning Corporation.
    c. Or equal.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ or ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
    d. Or equal.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; All-Service Duct Wrap.
    f. Or equal.

I. High-Temperature (greater than 250 deg F), Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; HTB 23 Spin-Glas.
    b. Owens Corning; High Temperature Flexible Batt Insulations.
    c. Or equal.

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ or with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Johns Manville; 800 Series Spin-Glas.
    d. Knauf Insulation; Insulation Board.
    e. Manson Insulation Inc.; AK Board.
    f. Owens Corning; Fiberglas 700 Series.
    g. Or equal.

K. High-Temperature (greater than 250 deg F), Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Fibrex Insulations Inc.; FBX.
    b. Johns Manville; 1000 Series Spin-Glas.
    c. Owens Corning; High Temperature Industrial Board Insulations.
    d. Rock Wool Manufacturing Company; Delta Board.
    e. Roxul Inc.; Roxul RW.
    f. Thermafiber; Thermafiber Industrial Felt.
    g. Or equal.

L. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.
f. Or equal.

M. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi rigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.
f. Or equal.

N. Removable Insulation Blanket Covers:

1. Removable and replaceable thermal blanket insulating system complete with insulation and jacketing, including the following:

a. Inner Jacket: 16.5 oz./sq. yd. PTFE Teflon impregnated fiberglass.
b. Cloth Outer Jacket: 16.5 oz./sq. yd. PTFE Teflon impregnated fiberglass cloth double sewn.
c. Lock Stitch Blanket Construction: Double sewn lock stitch with a minimum of 7 stitches per inch. Raw jacket edges will have a trifold PTFE Teflon fiberglass cloth binding with Teflon coated fiberglass thread stitching.
d. Quilting Pins: Stainless steel tufts or pins placed at random locations no greater than 16” inches apart, with stainless steel speed washers for securing the quilting pin stem in place.
e. Fastening Options: Stainless Steel "D" ring strap with Velcro tab both matching straps are spaced along the closing seam edge no greater than 8" apart.
f. Insulation thickness: 2-inch minimum thickness, or as indicated on insulation schedule in Part 3.

2. Products:

a. Shanon Enterprises of W.N.Y., Inc.; Insultech LT 450TT.
b. Or equal.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1 or 2-hour fire rating as required by the installation and by a NRTL acceptable to Campus Fire Marshal.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.
g. Or equal.

2.3 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
c. Or equal.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.
d. Or equal.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Design Polymerics
b. Or equal.

2. For indoor applications and to comply with LEED-NC Credit EQ 4.1, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.
e. Or equal.

2. For indoor applications and to comply with LEED-NC Credit EQ 4.1, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Design Polymerics
b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
c. Marathon Industries, Inc.
d. Or equal.

2. For indoor applications and to comply with LEED-NC Credit EQ 4.1, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Design Polymerics
b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
c. Marathon Industries, Inc.
d. Or equal.

2. For indoor applications and to comply with LEED-NC Credit EQ 4.1, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); 739, Dow Silicone.
    b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Speedline Corporation; Speedline Vinyl Adhesive.
    e. Or equal.

2. For indoor applications and to comply with LEED NC Credit EQ 4.1, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-35.
    b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    c. ITW TACC, Division of Illinois Tool Works; CB-50.
    d. Marathon Industries, Inc.; 590.
    e. Mon-Eco Industries, Inc.; 55-40.
    f. Vimasco Corporation; 749.
    g. Or equal.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-10.
    b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    d. Marathon Industries, Inc.; 550.
    e. Mon-Eco Industries, Inc.; 55-50.

f. Vimasco Corporation; WC-1/WC-5.
g. Or equal.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.
f. Or equal.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fireresistant lagging cloths over duct, equipment, and pipe insulation.
4. Service Temperature Range: Minus 50 to plus 180 deg F.
5. Color: White.

2.7 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-76.
   b. Foster Products Corporation, H. B. Fuller Company; 30-45.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.
   f. Vimasco Corporation; 750.
   g. Or equal.

B. Metal Jacket Flashing Sealants

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-76-8.
   b. Dow Corning

c. Foster Products Corporation, H. B. Fuller Company; 95-44.
d. Or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
e. Or equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.
d. Or equal.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene or kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene or kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) End caps.
4) Beveled collars.
5) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried or trench Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil. (Not required for pre-insulated piping systems.)

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pittsburgh Corning Corporation; Pittwrap.
b. Polyguard; Insulrap No Torch 125.
c. Or equal.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.

c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
e. Or equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
e. Or equal.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.
e. Or equal.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.

b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
e. Or equal.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.
d. Or equal.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
3. Springs: For larger than 84-inch diameter tank applications. Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.
5) Or equal.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.
5) Or equal.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

3. Self-Sticking-Base Insulation Hangers for Equipment: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Self-sticking-base is not acceptable for use with ductwork insulation. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.
4) Or equal.

b. Baseplate: Galvanized carbon-steel sheet, 0.015 inch thick by 2 inches square.
c. Spindle: Low carbon steel, fully annealed, 0.105-inch-diameter (12 gage) shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

C. Wire: or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.
e. Or equal.

2.12 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints.

I. Install insulation with least number of joints practical.

J. On chilled water systems, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments. On heating hot water systems, insulation to encapsulate hanger.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

Q. Existing pipe insulation damaged or affected by the work of this contract shall be repaired to comply with these specifications except that materials and thicknesses may match existing unless otherwise directed by the University’s Representative.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins, speed washers, and or Bonding

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not over compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with aluminum bands.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch pre-stressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch pre-stressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, hand holes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, hand holes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Hot Service Pumps: Insulation blanket with 1" thick silicone blanket.

2. Chilled Water Pumps: 2 in. 3 lb fiberglass board with .016 in. thick aluminum jacket.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

C. Insulation Installation on Fittings, Couplings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, couplings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated. On heating hot water systems, insulation to stop at valves.
2. Insulate pipe elbows using preformed fitting insulation Fitting insulation will be TIW or fiberglass. Insert provided by PVC fitting manufacturer. PVC covers to be 25/50 rated smoke safe.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. PVC covers with factory applied inserts are acceptable.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. PVC covers with factory applied inserts are acceptable.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, and flanges. Terminate ends with PVC end caps or vapor barrier mastic. Tape PVC covers to adjoining insulation facing using PVC tape.

D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with mastic.

E. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body. PVC covers with factory applied inserts are acceptable.
4. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with factory applied ASJ finish.

3.7 REMOVABLE INSULATION JACKETING COVER APPLICATION

A. Apply removable insulating jacketing system on Heating Hot-Water (HHW), and High Temperature Hot-Water (HTW) systems, and other heating water systems as follows:

1. Valves.
2. Strainers.
3. Pumps.
4. Regulators.
5. Flow meters.
6. Flow control, balancing, and instrumentation devices.
7. Steam Trap assemblies.
8. Service connection piping to heat exchangers.

9. At VAV terminal units insulation to stop at valve trim

B. Blanket Overlap: Blanket will overlap mating flanges as well as existing insulation with a minimum of 2” overlap. Where blanket cannot overlap existing oversized insulation, blanket will butt up to existing insulation with a friction closing seam. Open gaps are not acceptable. Blanket diameters which are 2” larger than existing insulation must be capped to eliminate open air void.

C. Any one piece will not exceed 50 lbs. in weight.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Couplings, Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each section with factory applied ASJ facing with Self Seal Lap (SSL).

If SSL is not provided:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

5. PVC Flange Cover with factory applied insulation insert is acceptable.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

3. PVC Cover with factory applied insulation insert is acceptable.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. Install self-adhesive pins on bottom of horizontal ducts and sides of vertical ducts per manufacturer recommendation. If recommendation not provided, install:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. Pins and adhesive may be omitted from top surface of horizontal, rectangular ducts and plenums.
    c. Do not over compress insulation during installation.
    d. Impale insulation over pins and attach speed washers.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket. Install vapor barrier tape at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Install self-adhesive pins and speed washers or cupped-head, capacitor discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins and adhesive may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Zshaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier tape.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

D. Confirm that duct installer has provided adequate hangers for the added weight of the fire-rated insulation.

3.13 FINISHES

A. Duct, Equipment, and Pipe Insulation that is concealed with ASJ.

B. Duct, Equipment, and Pipe Insulation that is exposed in mechanical rooms, exterior of the building envelope, or in a tunnel with aluminum jacket.

C. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections when requested and in the presence of University's Representative. The University will on request test and inspection if there is a concern with the installer's workmanship.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by University's Representative, by removing field applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each 20,000 cfm duct system.
2. Inspect field-insulated equipment, randomly selected by University's Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation.

Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

3. Inspect pipe, fittings, strainers, and valves, randomly selected by University's Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.15 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in non-conditioned space.
4. Indoor, exposed return located in non-conditioned space.
5. Outdoor, concealed supply and return.
6. Outdoor, exposed supply and return.
7. Sound attenuators or duct silencers if used in an insulated duct.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.
7. Nameplates and data plates

3.16 DUCT AND PLENUM INSULATION SCHEDULE

DUCT INSULATION TABLE (INSTALL ON EXTERIOR OF DUCT)							
DUCT LOCATION	DUCT TYPE	TYPE	THICKNESS/R-VALUE (IN BTU/HR-FT^2-F)			JACKET	VAPOR BARRIER
			SUPPLY	RETURN	OUTSIDE AIR		

Mechanical, Machine & Utility Rooms	Round & Rectangular	blanket	1.5”/4.2	1.5”/4.2	1”/4.3	Factory FSK	Yes
Outdoors (on roof, or exposed)	Round & Rectangular	Internally lined	2”/8.7	2”/8.7	None	N/A	No
Indoors – Concealed (conditioned space)	Round & Rectangular	Blanket	1½”/4.2	None	1½”/4.2	Foil Scrim Kraft (reinforced)	Yes
Indoors – Concealed (nonconditioned space)	Round & Rectangular	Blanket	1½”/4.2	1½”/4.2	1½”/4.2	Foil Scrim Kraft (reinforced)	Yes
Indoors – Exposed within conditioned space	Round & Rectangular	Rigid	None	None	None	None	No
Indoors – Exposed within Nonconditioned space	Round & Rectangular	blanket	1.5”/8.7	None	None	None	Yes

3.17 EQUIPMENT INSULATION SCHEDULE, GENERAL

A. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section. Provide removable insulation blanket covers on all un-insulated parts of boilers, heaters, heat exchangers, tanks, etc., that could accidentally be touched and cause a burn to maintenance staff.

B. Insulate the following indoor equipment:

1. Chilled-water centrifugal pump housings.
2. Hot-water centrifugal pump housings.
3. Domestic hot-water heaters and/or storage tanks, not factory insulated.
4. Heating hot-water air separators (small tanks).
5. Heat exchangers, not factory insulated.
6. Condensate receivers, not factory insulated.
7. Steam generators, not factory insulated.
8. Blowdown tanks, not factory insulated.
9. Flash tanks, not factory insulated.
10. Boilers, not factory insulated.

C. Omit insulation, except for chilled water system equipment, from the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.18 EQUIPMENT INSULATION SCHEDULE

EQUIPMENT SERVICE	INSULATION THICKNESS	INSULATION TYPE	JACKET MATERIAL	VAPOR BARRIER	MINIMUM INSTALLED R-VALUE
35°F to 75°F (chilled-water heat exchangers, pumps and equipment)	2”	Mineral Fiber elastomeric	NA	Yes	7.1
<200°F (HHW, domestic and industrial water heat exchangers, pumps and equipment)	2”	Mineral fiber elastomeric	NA	No	5.6
>200°F (high temperature water, and steam heat exchangers and equipment)	4”	High temp glass blanket	Grey Silicone cloth/Blanket	No	10.6

3.19 PIPING INSULATION SCHEDULE, GENERAL

A. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.20 INTERIOR PIPING INSULATION SCHEDULE

A. Service: Chilled-water supply and return.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Fiberglass Piping Insulation ASJ Finish.
3. Insulation Thickness: Apply the following insulation thicknesses:

    a. Copper pipe, Up to 2” diameter: 1” insulation
    b. Steel pipe, 2-1/2” and larger: 1” insulation

4. Field-Applied Jacket: Aluminum in mech. room less than 8’ and roof piping..
5. Vapor Retarder Required: Yes.
6. Finish: None.

C. Service: Condenser-water supply and return, when directed by the University's Representative.

1. Operating Temperature: 50 to 105 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses: 3/4".
4. Field-Applied Jacket: Aluminum in mech. room less than 8' and roof piping.
5. Vapor Retarder Required: No.
6. Finish: None.

D. Service: Heating hot-water supply and return.

1. Operating Temperature: 100 to 200 deg F.
2. Insulation Material: Preformed Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:

    a. All Pipes, ¾" up to 1-1/4" branch lines: 1-1/2"
    b. All Pipes, 1-1/2" and larger: 2"

4. Field-Applied Jacket: Aluminum in mech. room less than 8' and roof piping.
5. Vapor Retarder Required: No.
6. Finish: None.

E. Service: Steam and condensate.

1. Operating Temperature: 450 deg F and lower.
2. Insulation Material: Preformed mineral fiber, with pre-molded mineral fiber fitting insulation.
3. Insulation Thickness: Apply the following insulation thicknesses:
4. Field-Applied Jacket: Aluminum in mech. room less than 8' and roof piping.
5. Vapor Retarder Required: No.
6. Finish: None.
7. Insulation Thickness: Apply the following insulation thicknesses:

PIPE SIZE	BRANCH TO 2", Note (1)	UP to 1"	1-1/4" to 2"	2-1/2" to 4"	5" and 6"	8" & LARGER
Steam, High Pressure	1.5"	2.5"	2.5"	3.0"	3.5"	3.5"
Steam, Med Pressure	1.5"	2.0"	2.5"	2.5"	3.5"	3.5"
Steam, Low Pressure	1.0"	1.5"	1.5"	2.0"	2.0"	3.5"
Steam Condensate	0.5"	1.5"	1.5"	1.5"	1.5"	1.5"

Note (1): Branch piping not exceeding 12 feet in length.

F. Service: Vents from condensate blow down tank, condensate receiver and steam relief valves.

1. Operating Temperature: 450 deg F or lower.
2. Insulation Material: High Temperature Mineral fiber, with jacket.
3. Insulation Thickness: Apply the following insulation thicknesses as listed for steam condensate in above table:
4. Field-Applied Jacket: Aluminum in mech. room less than 8’ and roof piping.
5. Vapor Retarder Required: No.
6. Finish: None.

3.21 EXTERIOR PIPING INSULATION SCHEDULE

A. All thickness per 3.20 above. Finish to be .016 Embossed Aluminum Jacketing.

B. Refer to Sections 232110 and 23 2213 for underground exterior chilled water and steam and condensate piping and insulation requirements.

END OF SECTION 23 0700

SECTION 23 0800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.
2. OPR documentation prepared by the University contains requirements that apply to this Section.

1.2 DEFINITIONS

A. Design Builder: Includes Design Builder, Architect, and Engineer design professionals responsible for design of HVAC, electrical, controls for HVAC systems, and other related systems identified in the Contract for Construction with the University.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. BoD: Basis of Design.

D. BoD-HVAC: HVAC systems basis of design.

E. CxA: Commissioning Authority.

F. OPR: Owner's (University) Project Requirements.

G. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

H. TAB: Testing, Adjusting, and Balancing.

1.3 DESIGN BUILDER'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Design Builder:

1. Attend procedures meeting for TAB Work.
2. Certify that TAB Work is complete.

C. Mechanical Subcontractor:

1. Attend TAB verification testing.
2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

D. HVAC Instrumentation and Control Subcontractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:

1) Accessibility of equipment and components required for TAB Work.
2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
5) Air and water flow rates have been specified and compared to central equipment output capacities.
6) Building's pressurization requirements.

b. Identify discontinuities and omissions in the Contract Documents.
c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation and Controls" and Sequence of Operation.

F. Electrical Subcontractor:

1. With the Mechanical Subcontractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

1.4 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.5 COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."

B. BoD HVAC: University will provide BoD-HVAC documents, to the CxA for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

C. Test Checklists: CxA with assistance of University's Representative shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences for HVAC systems.
4. Strength of control signal for each set point at specified conditions.
5. Responses to control signals at specified conditions.
6. Sequence of response(s) to control signals at specified conditions.
7. Electrical demand or power input at specified conditions.
8. Power quality and related measurements.
9. Expected performance of systems, subsystems, and equipment at each step of test.
10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
11. Interaction of auxiliary equipment.
12. Issues log.

1.6 SUBMITTALS

A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from Design Builder certifying that systems, subsystems, equipment, and associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Subcontractor as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

E. Certified Pipe Cleaning and Flushing Report: CxA shall certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.

F. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

G. Corrective Action Documents: CxA shall submit corrective action documents.

H. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.
3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.
5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

9. Annotate checklist or data sheet when a deficiency is observed.
10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

    a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
    b. Operation of terminal units in both heating and cooling cycles.
    c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
    d. Building pressurization.
    e. Total exhaust airflow and total outdoor-air intake.
    f. Operation of indoor-air-quality monitoring systems.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

    a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
    b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. Operational modes include the following:

1. Occupied and unoccupied.
2. Warm up and cool down.
3. Economizer cycle.
4. Emergency power supply.
5. Life-safety and safety systems.
6. Smoke control.
7. Fire safety.
8. Stair pressurization system.
9. Temporary upset of system operation.
10. Partial occupancy conditions.
11. Special cycles.

3.2 TAB VERIFICATION

A. TAB Subcontractor shall coordinate with CxA for work required in Division 23 Section "Testing, Adjusting, and Balancing for HVAC." TAB Subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. Design Builder, HVAC Subcontractor, and CxA shall witness TAB Work.

C. TAB Preparation:

1. TAB Subcontractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

    a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Ductwork Air Leakage Testing:

1. All portions of the mechanical room ducts, riser ducts and main trunk duct systems shall have ductwork air leakage testing. Only branch ducts downstream of terminal units and ductwork within the conditioned space shall not be tested. Ductwork air leakage testing shall be performed according to Division 23 Section "Metal Ducts," and shall be witnessed by the CxA.
2. On approval of preliminary ductwork air leakage testing report, the CxA shall coordinate verification testing of ductwork air leakage testing. Verification testing shall include random retests of portions of duct section tests, reported in preliminary ductwork air leakage testing report. The HVAC Subcontractor shall perform tests using the same instrumentation (by model and serial number) as for original testing; the CxA shall witness verification testing.

E. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.
2. CxA shall notify TAB Subcontractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item is defined as follows:

    a. For all readings other than sound, a deviation of more than 10 percent.
    b. For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)

4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

F. If deficiencies are identified during verification testing, CxA shall notify the HVAC Subcontractor and University's Representative, and shall take action to remedy the deficiency. Design Builder and University's Representative shall review final tabulated checklists and data

sheets to determine if verification is complete and that system is operating according to the Contract Documents.

G. CxA shall certify that TAB Work has been successfully completed.

3.3 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of HVAC Subcontractor Testing:

1. Testing scope shall include entire HVAC installation for the project, from point of connection for high temperature water and for chilled water generation through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Detailed Testing Procedures: CxA, with HVAC Subcontractor, TAB Subcontractor, and HVAC Instrumentation and Control Subcontractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

E. Boiler Testing and Acceptance Procedures (if applicable): Testing requirements are specified in Division 23 boiler Sections. CxA shall review and comment on submittals, test data, inspector record, and boiler certification and shall compile information for inclusion in systems manual.

F. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Controls" and Sequence of Operation. The CxA, HVAC Subcontractor, and the HVAC Instrumentation and Control Subcontractor shall collaborate to prepare testing plans.

2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

G. Pipe cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 Sections. HVAC Subcontractor shall prepare pipe system cleaning, flushing, and hydrostatic testing. CxA shall review and comment on plan and final reports. CxA shall certify that pipe cleaning, flushing, hydrostatic tests, and chemical treatment have been completed. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

H. Energy Supply System Testing (if applicable): HVAC Subcontractor shall prepare a testing plan to verify performance of hot-water systems and equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each equipment item and pipe section to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

I. Heat-Generation System Testing (if applicable): HVAC Subcontractor shall prepare a testing plan to verify performance of boilers, feedwater equipment, furnaces, and auxiliary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

J. Refrigeration System Testing (if applicable): HVAC Subcontractor shall prepare a testing plan to verify performance of, refrigerant compressors and condensers, and other refrigeration systems. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings

showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

K. HVAC Distribution System Testing: HVAC Subcontractor shall prepare a testing plan to verify performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

L. Vibration and Sound Tests: HVAC Subcontractor shall prepare testing plans to verify performance of vibration isolation and seismic controls. CxA shall witness and certify tests and inspections.

M. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to University's Representative. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

N. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
3. Prepare a preliminary test report. Deficiencies will be evaluated by University's Representative to determine corrective action. Deficiencies shall be corrected and test repeated.
4. If it is determined that the system is constructed according to the Contract Documents, University's Representative will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, University's Representative will decide if tests shall be repeated and a revised report submitted.

END OF SECTION 23 0800

SECTION 23 0900 - INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls. Building Management System (BMS) functions such as building equipment and building systems monitoring, alarm notification and reporting through the campus-wide BMS network for campus Facilities Management central operating plant supervision. B. Related Sections include the following:

1. Division 23 Section “Air Duct Accessories” and “Custom Air Handling Units” for control dampers.
2. Division 26 Section "Lighting Control Devices" for building lighting control system.
3. Division 28 Section "Digital Addressable Fire Alarm System" for fire and smoke detectors mounted in HVAC systems and equipment.

1.2 DEFINITIONS

A. BAC: Building Automated Control System (same as BMS).

B. BMS: Building Management System.

C. DDC: Direct-digital controls.

D. LAN: Local area network.

E. MS/TP: Master-slave/token-passing.

F. PICS: Protocol Implementation Conformance Statement.

1.3 SYSTEM DESCRIPTION

A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in a multi-user, multitasking environment on token-passing network and programmed to control mechanical systems.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, sensing devices, and control devices.
2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
3. Details of control panel faces, including controls, instruments, and labeling.
4. Written description of sequence of operation.
5. Schedule of dampers including size, leakage, and flow characteristics.
6. Schedule of valves including size, type, leakage and flow characteristics.
7. Network Diagram: Detail network design, showing control composite with controllers, sub-systems, interface equipment, gateways and showing connection method to controlled and monitored systems and equipment. Diagram shall give an overview of work to be performed and shall indicate which contractor shall be responsible for providing hardware necessary to integrate sub-system control systems.
8. Trunk Cable Schematic: Showing programmable control unit locations and trunk data conductors.
9. Listing of connected data points, including connected control unit and input device.
10. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
11. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

C. Samples: For each color required, of each type of thermostat cover.

D. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

E. Software Upgrade Kit: For University to use in modifying software to suit future power system revisions or monitoring and control revisions.

F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

G. Maintenance Data: For systems to include in maintenance manuals specified in Division 01. Include the following:

1. Maintenance instructions and lists of spare parts for each type of control device, electronic control cabinet and compressed-air station.

2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

I. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences and set points established during commissioning.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the automatic control system manufacturer for both installation and maintenance of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature control systems similar to those indicated for this Project and with a record of successful in-service performance.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University's Representative, and marked for intended use.

D. Comply with California Mechanical Code, "Installation of Air Conditioning and Ventilation Systems."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.7 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 26 Section "Lighting Control Devices" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate equipment with Division 28 Section "Digital Addressable Fire Alarm Systems" to achieve compatibility with equipment that interfaces with that system.

D. Coordinate supply of conditioned electrical circuits for control units and operator workstation.

E. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

F. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

G. Coordinate location of all control cabinets, conduit with Electrical, Mechanical, Fire Alarm, and Security subcontractors to ensure that all panelsconduits are accessible for maintenance and operation and that there is no duplication of effort in installing conduit and tubing supports. Division 26 will install their support rack with at least 25% extra capacity for control conduits and tubing. Division 26 will coordinate with controls electrician wherever rack will need to be made to accommodate the control electrician.

H. Room numbers: Confirm room numbers being used in programming are the final numbers assigned by Facilities Management.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the two following to be compatible with existing Campus Standard central energy monitoring control systems in fit, form and function:

1. Electric, Electronic, DDC Systems and Control Systems Components:

a. Apogee – Siemens Building Technologies to seamlessly tie into existing campus Ethernet energy management system 600 network.
b. Metasys – Johnson Controls, Inc., Controls Group (Branch network), to seamlessly tie into existing campus Ethernet energy management system 600 network. No distributors or local representatives will be acceptable.

2. Interface Graphic Software:

a. Wonderware Graphics - The DDC system shall communicate through a serial interface to the Wonderware Corporation protocol graphic software.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 DDC NETWORK COMMUNICATION AND OPERATOR WORKSTATION

A. Operator Station: Microcomputer station with printer.

B. Workstation: IBM-compatible microcomputer with minimum configuration as follows:

1. Processor: Intel, Pentium 4, 2.0 MHz.
2. Random-Access Memory: 1028 MB.
3. Cache Memory: 256 kB.
4. Graphics: Super video graphic adapter (SVGA), minimum 1280 x 1024 pixels, 128-MB EDO video memory.
5. Monitor: 17 inches, color, LCD type flat screen.
6. Keyboard: QWERTY, 105 keys in ergonomic shape.
7. Floppy-Disk Drives: 1.44 MB.
8. Hard-Disk Drive: 40 GB.
9. CD-Read/Write Drive: 48x.
10. Mouse: Three button.
11. Operating System: Microsoft Windows XP, or later.
12. Network Connection: Ethernet fiber optic connection.
13. Port Communication: USB interface ports to communicate with digital controllers, and printer.
14. UPS Backup Capacity: 30 minutes of operation required.

C. Printer: Color, ink-jet type as follows:

1. Print Head: 1440 x 1440 dpi photoquality color resolution.
2. Internal Memory Buffer: 32 kB.
3. Paper Handling: Minimum of 100 sheets.
4. Print Speed: Minimum of 8 ppm in black and 4 ppm in color.
5. Printer Communication: USB printer cable.

D. Application Software: Include the following:

1. Input/output capability from operator station.
2. Operator system access levels via software password.
3. Database creation and support.
4. Dynamic color graphic displays.
5. Alarm processing.
6. Event processing.
7. Automatic restart of field equipment on restoration of power.
8. Data collection.
9. Graphic development on workstation.
10. Maintenance management.

E. The design of the BAS shall network operator workstations and stand-alone DDC Controllers. The network architecture shall consist of three levels, a campus-wide (Management Level Network) Ethernet network based on TCP/IP protocol, high performance peer-to-peer building level network(s) and DDC Controller floor level local area networks with access being totally transparent to the user when accessing data or developing control programs.

F. The design of BAS shall allow the co-existence of new DDC Controllers with existing DDC Controllers in the same network without the use of gateways or protocol converters.

G. System shall have the capability to be an OPC Server for dynamic communication with OPC Clients over an Ethernet network. At a minimum, the following must be supported:

H. Peer-to-Peer Building Level Network:

1. All operator devices either network resident or connected via dial-up modems shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer network. No hardware or software limits shall be imposed on the number of devices with global access to the network data at any time.
2. The peer-to-peer network shall support a minimum of 100 DDC controllers and PC workstations
3. Each PC workstation shall support a minimum of 4 peer to peer networks hardwired or dial up.
4. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for interprocess control. All exchange points shall have full system functionality as specified herein for hardwired points.
5. Field panels must be capable of integration with open standards including Modbus, BACnet, and Lonworks as well as with third party devices via existing vendor protocols.
6. Telecommunication Capability:

    a. Auto-dial/auto-answer communications shall be provided to allow DDC Controllers to communicate with remote operator stations and/or remote terminals via telephone lines, as indicated in the sequence of operations.
    b. Auto-dial DDC Controllers shall automatically place calls to workstations to report alarms or other significant events. The auto-dial program shall include provisions for handling busy signals, "no answers" and incomplete data transfers.
    c. Operators at dial-up workstations shall be able to perform all control functions, all report functions and all database generation and modification functions as described for workstations connected via the network. Routines to automatically answer calls from remote DDC or HVAC Mechanical Equipment Controllers shall be inherent in the Controller. The use of additional firmware or software is not acceptable. The fact that communications are taking place with remote DDC or HVAC & Mechanical Equipment Controllers over telephone lines shall be completely transparent to an operator.
    d. Multiple modems shall be supported by DDC or HVAC & Mechanical Equipment Controllers on the Peer-to-Peer Network to ensure continuous communication to workstation.

I. Management Level Network:

1. All PCs shall simultaneously direct connect to the Ethernet and Building Level Network without the use of an interposing device.
2. Operator Workstation shall be capable of simultaneous direct connection and communication with BACnet, OPC, and Apogee networks without the use of interposing devices.

3. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.
4. When appropriate, any controller residing on the peer to peer building level networks shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.
5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet, as well as, directly connected building level networks. Any PC shall be able to interrogate any controller on the building level network.
6. Any break in Ethernet communication from the PC to the controllers on the building level networks shall result in an alarm notification at the PC.
7. The Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
8. Access to the system database shall be available from any client workstation on the Management Level Network.

2.3 DDC CONTROLLER FLOOR LEVEL NETWORK:

A. This level communication shall support a family of application specific controllers and shall communicate with the peer-to-peer network through DDC Controllers for transmission of global data.

2.4 DDC & HVAC MECHANICAL EQUIPMENT CONTROLLERS

A. The DDC & HVAC Mechanical Equipment Controllers shall reside on the Building Level Network and communicate directly with the server using industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3. Each DDC & HVAC Controller is to be directly connected to the existing campus FACNET domain via Ethernet connection.

B. DDC & HVAC Mechanical Equipment Controllers shall use the same programming language and tools. DDC & HVAC Mechanical Equipment Controllers which require different programming language or tools on a network are not acceptable.

C. DDC & HVAC Mechanical Equipment Controllers which do not meet the functions specified in Section 2.4.1 and Section 2.5 for DDC Controllers or Section 2.4.2 and Section 2.5 for HVAC Mechanical Equipment Controllers are not acceptable.

D. DDC Controllers shall be a 16-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point I/O schedule. Each controller shall support a minimum of three (3) Floor Level Application Specific Controller Device Networks.

E. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:

1. Control processes.

2. Energy management applications.
3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
4. Historical/trend data for points specified.
5. Maintenance support applications.
6. Custom processes.
7. Operator I/O.
8. Dial-up communications.
9. Manual override monitoring.

F. Each DDC Controller shall support firmware upgrades without the need to replace hardware.

G. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.

H. DDC Controllers shall provide a minimum two RS-232C serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. DDC Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals. Controllers shall have industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3 connections.

I. As indicated in the point I/O schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.

1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.

J. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.

K. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

L. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:

1. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V.

2. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact.
3. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power.
4. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max).
5. Isolation shall be provided at all peer-to-peer panels' AC input terminals to suppress induced voltage transients consistent with:

    a. IEEE Standard 587-1980.
    b. UL 864 Supply Line Transients.
    c. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11).

M. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days.

1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

N. Provide a separate DDC Controller for each AHU or other HVAC system as indicated in Section 3.02. It is intended that each unique system be provided with its own point resident DDC Controller.

O. HVAC Mechanical Equipment Controllers shall be a 12-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors.

P. Each HVAC Mechanical Controller shall have sufficient memory to support its own operating system and databases, including:

1. Control processes.
2. Energy management applications.
3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
4. Historical/trend data for points specified.
5. Maintenance support applications.
6. Custom processes.
7. Operator I/O.
8. Dial-up communications.

Q. Each HVAC Mechanical Equipment Controller shall support firmware upgrades without the need to replace hardware.

R. HVAC Mechanical Equipment Controllers shall provide a RS-232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals.

S. HVAC Mechanical Equipment Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

T. Each HVAC Mechanical Equipment Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all components. The HVAC Mechanical Equipment Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

U. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:

1. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V.
2. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact.
3. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power.
4. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max).
5. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:

    a. IEEE Standard 587-1980.
    b. UL 864 Supply Line Transients.
    c. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11).

V. In the event of the loss of normal power, there shall be an orderly shutdown of all HVAC Mechanical Equipment Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

1. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention.
2. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of reloading the HVAC Mechanical Equipment Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

2.5 DDC & HVAC MECHANICAL EQUIPMENT CONTROLLER RESIDENT SOFTWARE FEATURES

A. General: The software programs specified in this Section shall be provided as an integral part of DDC and HVAC Mechanical Equipment Controllers and shall not be dependent upon any higher level computer for execution.

1. All points shall be identified by up to 30 character point name and 16 character point descriptor. The same names shall be used at the PC workstation.
2. All digital points shall have user defined two-state status indication (descriptors with minimum of 8 characters allowed per state (i.e. summer/winter)).

B. Control Software Description:

1. The DDC and HVAC Mechanical Equipment Controllers shall have the ability to perform the following pre-tested control algorithms:

   a. Two-position control.
   b. Proportional control.
   c. Proportional plus integral control.
   d. Proportional, integral, plus derivative control.
   e. Automatic tuning of control loops.

C. DDC and HVAC Mechanical Equipment Controllers shall provide the following energy management routines for the purpose of optimizing energy consumption while maintaining occupant comfort.

1. Start-Stop Time Optimization (SSTO) shall automatically be coordinated with event scheduling. The SSTO program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by time of occupancy. The SSTO program shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period, and still maintain desired comfort conditions.

   a. The SSTO program shall operate in both the heating and cooling seasons.

      1) It shall be possible to apply the SSTO program to individual fan systems.
      2) The SSTO program shall operate on both outside weather conditions as well as inside zone conditions and empirical factors.

   b. The SSTO program shall meet the local code requirements for minimum outside air while the building is occupied.

2. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or groups of points according to a stored time.

   a. It shall be possible to individually command a point or group of points.
   b. For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start or stop within that group.
   c. The operator shall be able to define the following information:

      1) Time, day.
      2) Commands such as on, off, auto, and so forth.
      3) Time delays between successive commands.

4) There shall be provisions for manual overriding of each schedule by an appropriate operator.

d. It shall be possible to schedule events up to one year in advance.

1) Scheduling shall be calendar based.
2) Holidays shall allow for different schedules.

3. Enthalpy switchover (economizer) .The Energy Management Control Software (EMCS) will control the position of the air handler relief, return, and outside air dampers. If the outside air dry bulb temperature falls below changeover set point the EMCS will modulate the dampers to provide 100 percent outside air. The user will be able to quickly changeover to an economizer system based on dry bulb temperature and will be able to override the economizer cycle and return to minimum outside air operation at any time.
4. Temperature-compensated duty cycling.

a. The DCCP (Duty Cycle Control Program) shall periodically stop and start loads according to various patterns.
b. The loads shall be cycled such that there is a net reduction in both the electrical demands and the energy consumed.

5. Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.
6. Night setback control: The system shall provide the ability to automatically adjust setpoints for night control.
7. The Peak Demand Limiting (PDL) program shall limit the consumption of electricity to prevent electrical peak demand charges.

a. PDL shall continuously track the amount of electricity being consumed, by monitoring one or more electrical kilowatt-hour/demand meters. These meters may measure the electrical consumption (kWh), electrical demand (kW), or both.
b. PDL shall sample the meter data to continuously forecast the demand likely to be used during successive time intervals.
c. If the PDL forecasted demand indicates that electricity usage is likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads.
d. Once the demand peak has passed, loads that have been shed shall be restored and returned to normal control.

D. DDC and HVAC Mechanical Equipment Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. A single process shall be able to incorporate measured or calculated data from any and all other DDC and HVAC Mechanical Equipment Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC and HVAC Mechanical Equipment Controllers on the network. Database shall support 30 character, English language point names, structured for searching and logs.

2. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.
3. DDC and HVAC Mechanical Equipment Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task orientated information from the user manual.
4. DDC and HVAC Mechanical Equipment Controller shall be capable of comment lines for sequence of operation explanation.

E. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC and HVAC Mechanical Equipment Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC and HVAC Mechanical Equipment Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

1. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
2. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DDC Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each DDC and HVAC Mechanical Equipment Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
3. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs based on time (after hours destinations) or based on priority.
4. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
5. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.

F. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.

1. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC and HVAC Mechanical Equipment Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of l minute to 7 days shall be provided. Each DDC and HVAC Mechanical Equipment Controller shall have a dedicated RAM-based buffer for trend data and shall be capable of storing a minimum of __ data samples. All trend data shall be available for transfer to a Workstation without manual intervention.
2. DDC and HVAC Mechanical Equipment Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated

automatic and manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary.

a. Loop tuning shall be capable of being initiated either locally at the DDC and HVAC Mechanical Equipment Controller, from a network workstation or remotely using dial-in modems. For all loop tuning functions, access shall be limited to authorized personnel through password protection.

G. DDC and HVAC Mechanical Equipment Controllers shall be capable of automatically accumulating and storing run-time hours for digital input and output points and automatically sample, calculate and store consumption totals for analog and digital pulse input type points, as specified in the point I/O schedule.

H. The peer to peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to access any data from or send control commands and alarm reports directly to any other DDC and HVAC Mechanical Equipment Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC and HVAC Mechanical Equipment Controllers shall send alarm reports to multiple workstations without dependence upon a central or intermediate processing device. The peer to peer network shall also allow any DDC and HVAC Mechanical Equipment Controller to access, edit, modify, add, delete, back up, and restore all system point database and all programs.

1. The peer to peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to assign a minimum of 50 passwords access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust and control the points that the operator is authorized for. All other points shall not be displayed on the PC workstation or portable terminal (e.g. all base building and all tenant points shall be accessible to any base building operators, but only tenant points shall be accessible to tenant building operators). Passwords and priorities for every point shall be fully programmable and adjustable.

2.6 FLOOR LEVEL NETWORK APPLICATION SPECIFIC CONTROLLERS (ASC)

A. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (ASCs) through Floor Level LAN Device Networks.

B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Provide the following types of ASCs as a minimum:

1. Central System Controllers.
2. Terminal Equipment Controllers.

C. Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.

D. Central System Controllers:

1. Provide for control of central HVAC systems and equipment including, but not limited to, the following:

    a. Custom or Built-up air handling systems.
    b. Laboratory Exhaust System interfacing with building Air Handling Systems.
    c. Process Chilled water systems.
    d. Heating Hot Water Heat Exchangers systems.
    e. Steam and back-up Steamsystems.

2. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Provide a hand/off/automatic switch for each digital output for manual override capability. Switches shall be mounted either within the controller's key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides. In addition, each switch position shall be supervised in order to inform the system that automatic control has been overridden.
3. Each controller shall support its own real-time operating system. Provide a time clock with battery backup to allow for stand-alone operation in the event communication with its DDC Controller is lost and to insure protection during power outages.
4. All programs shall be field-customized to meet the user's exact control strategy requirements. Central System controllers utilizing pre-packaged or canned programs shall not be acceptable. As an alternative, provide DDC Controllers for all central equipment in order to meet custom control strategy requirements.
5. Programming of central system controllers shall utilize the same language and code as used by DDC Controllers to maximize system flexibility and ease of use. Should the system controller utilize a different control language, provide a DDC Controller to meet the specified functionality.
6. Each controller shall have connection provisions for a portable operator's terminal. This tool shall allow the user to display, generate or modify all point databases and operating programs.

E. Terminal Equipment Controllers:

1. Provide for control of each piece of equipment, including, but not limited to, the following:

    a. Variable Air Volume (VAV) boxes.
    b. Unit Conditioners.
    c. Unit Ventilators.
    d. Room Pressurization.

2. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24V floating control, 0-10v, allowing for interface to a variety of modulating actuators.
3. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the FLN, BLN or MLN is not acceptable. F. Digital Energy Monitors:

1. Provide three phase digital watt-meters with pre-wired CTs. All watt-meter electronics shall be housed within the CTs. CTs shall include sizes capable of mounting directly on a power bus. Diagnostics visible to the installing electrician (without an operator tool) shall indicate: proper operation, mis-wiring or low power-factor, device malfunction, and over-load condition. The meters shall include the following:

    a. The device shall be UL Listed, and shall comply with ANSI C12.1 accuracy specification. The minimum CT/meter combined accuracy shall be no greater than 1% of reading over the range of 5% to 100% of rated load. The meter shall not require calibration.
    b. The wattmeter shall directly connect to power from 208 through 480 with no potential transformer. In-line fuses for each voltage tap phase shall be included.
    c. The wattmeter CTs shall be split-core and at minimum be sized to accommodate loads ranging from 100 to 2400 Amps. The CTs shall be volt-signal type, and shall not require shorting blocks.
    d. The wattmeter shall reside directly on the Floor Level Network along with other FLN devices. Data transferred shall include:

        1) kW & kWH.
        2) Consumption.
        3) Demand.
        4) Power Factor.
        5) Current.
        6) Voltage.
        7) Apparent Power.
        8) Reactive Power.

2.7 LOCAL USER DISPLAY

A. Where specified in the sequence of operation or points list, the controllers on the peer to peer building level network shall have a display and keypad for local interface. A keypad shall be provided for interrogating and commanding points in the controller.

1. The display shall use the same security password and access rights for points in the display as is used in the associated controller.
2. The LCD display shall be a minimum of a 2 line 40 character display.
3. The LCD display shall include the full point name, value (numeric, digital or state text), point priority and alarm status on one screen.
4. The LCD shall dynamically update the value, priority, and alarm status for the point being displayed.
5. The display shall be mounted either on the door of the enclosure or remote from the controller.

2.8 WORKSTATION OPERATOR INTERFACE

A. Basic Interface Description:

1. Operator workstation interface software shall minimize operator training through the use of English language prompting, 30 character English language point identification, online help, and industry standard PC application software. Interface software shall simultaneously communicate with up to 4 Building Level Networks and share data between any of the 4 networks. The software shall provide, as a minimum, the following functionality:

    a. Real-time graphical viewing and control of environment.
    b. Scheduling and override of building operations.
    c. Collection and analysis of historical data.
    d. Point database editing, storage and downloading of controller databases.
    e. Alarm reporting, routing, messaging, and acknowledgment.
    f. Display dynamic data trend plot:

        1) Must be able to run multiple plots simultaneously.
        2) Each plot must be capable of supporting 10 pts/plot minimum.
        3) Must be able to command points directly off dynamic trend plot application.

    g. Definition and construction of dynamic color graphic displays.
    h. Program editing.
    i. Transfer trend data to 3rd party software.
    j. Scheduling reports.
    k. Operator Activity Log.
    l. Open communications via OPC Server.
    m. Open communications via BACnet Client & Server.

2. Provide a graphical user interface which shall minimize the use of keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection.
3. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. BAS software shall run on a Windows NT 32 bit operating. These Windows applications shall run simultaneously with the BAS software. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BAS alarms and monitoring information.

    a. Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via user-sized windows. Operator shall be able to drag and drop information between applications, reducing the number of steps (i.e. Click on a point on the alarm screen and drag it to the dynamic trend graph application to initiate a dynamic trend).

        1) Dynamic color graphics and graphic control.
        2) Alarm management, routing to designated locations, and customized messages.
        3) Year in advance event and report scheduling.
        4) Dynamic trend data definition and presentation.

5) Graphic definition and construction.
6) Program and point database editing on-line.

b. If the software is unable to display several different types of displays at the same time, the BAS contractor shall provide at least two operator workstations.
c. Report and alarm printing shall be accomplished via Windows Print Manager, allowing use of network printers.

4. Operator specific password access protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported).
5. Reports shall be generated on demand or via pre-defined schedule and directed to CRT displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:

a. A general listing of all or selected points in the network.
b. List of all points currently in alarm.
c. List of all points currently in override status.
d. List of all disabled points.
e. List of all points currently locked out.
f. List of user accounts and access levels.
g. List all weekly schedules.
h. List of holiday programming.
i. List of limits and deadbands.
j. Custom reports from 3rd party software.
k. System diagnostic reports including, list of DDC panels on line and communicating, status of all DDC terminal unit device points.
l. List of programs.

6. Scheduling and Override:

a. Provide a calendar type format for simplification of time-of-day scheduling and overrides of building operations. Schedules reside in the PC workstation, DDC Controller, and HVAC Mechanical Equipment Controller to ensure time equipment scheduling when PC is off-line, PC is not required to execute time scheduling. Provide override access through menu selection or function key. Provide the following spreadsheet graphic types as a minimum:

1) Weekly schedules.
2) Zone schedules, minimum of 200 unique zones.
3) Scheduling for up to 365 days in advance.
4) Schedule reports to print at PC.

7. Collection and Analysis of Historical Data:

a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.
b. Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of at least six points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. DDC contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times, equipment efficiency, and/or building environmental conditions. DDC contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.

B. Dynamic Color Graphic Displays:

1. At the Central Plant, the system shall communicate through a serial interface to the Wonderware Corporation protocol graphic software. This interface shall be a program language, which communicates directly with the Wonderware program in the Central Plant, without the aid of a translator box, interface panel, or sub-program language or processor.
2. Create a minimum of 1 color graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units, chilled water systems and hot water boiler systems, and room level terminal units, shall be provided by the BAS contractor as indicated in the point I/O schedule of this specification to optimize system performance, analysis and speed alarm recognition.
3. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Graphics software shall permit the importing of Autocad or scanned pictures for use in the system.
4. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.

    a. Sizable analog bars shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale. The user shall be able to "click and drag" the pointer to change the setpoint.
    b. Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.
    c. Equipment state can be changed by clicking on the point block or graphic symbol and selecting the new state (on/off) or setpoint.
    d. State text for digital points can be defined up to eight characters.

5. Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.
6. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to

allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

7. A clipart library of HVAC and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and laboratory symbols. The user shall have the ability to add custom symbols to the clipart library.
8. A dynamic display of the site specific architecture showing status of controllers, PC workstations and networks shall be provided.

C. System Configuration & Definition:

1. Network wide control strategies shall not be restricted to a single DDC Controller or HVAC Mechanical Equipment controller, but shall be able to include data from any and all other network panels to allow the development of Global control strategies.
2. Provide automatic backup and restore of all DDC controller and HVAC Mechanical Equipment controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDC Controller or HVAC Mechanical Equipment Controller. Changes made at the DDC Controllers or HVAC Mechanical Equipment Controllers shall be automatically uploaded to the workstation, ensuring system continuity.
3. System configuration, programming, editing, graphics generation shall be performed online. If programming and system back-up must be done with the PC workstation off-line, the BAS contractor shall provide at least 2 operator workstations.

D. Alarm Management:

1. Alarm Routing shall allow the user to send alarm notification to selected printers or PC location based on time of day, alarm severity, or point type.
2. Alarm Notification shall be provided via two alarm icons, to distinguish between routine, maintenance type alarms and critical alarms. These alarm icons shall be displayed when user is working in other Windows programs. The BAS alarm display screen shall be displayed when the user clicks on the alarm icon.
3. Alarm Display shall list the alarms with highest priority at the top of the display. The alarm display shall provide selector buttons for display of the associated point graphic and message. The alarm display shall provide a mechanism for the operator to sort alarms.
4. Alarm messages shall be customizable for each point to display detailed instructions to the user regarding actions to take in the event of an alarm.

2.9 FIELD DEVICES

A. Provide instrumentation as required for monitoring, control or optimization functions.

B. Room Temperature Sensors: Digital room sensors shall have LCD display, day / night override button, and set point slide adjustment override options. Cover shall be white. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment.

1. Temperature Monitoring Range: +20/120°F.
2. Output signal: Changing Resistance.
3. Accuracy at Calibration Point: ±0.5°F.
4. Set Point and Display Range: 55° to 95° F.

C. Liquid Immersion Temperature:

1. The temperature sensors shall be furnished and installed in stainless steel wells that are threaded in the pipe using "thread-o-let" fittings or equivalent at locations approved by the University's Representative.
2. Each temperature sensor shall be resistance type fabricated with reference grade platinum wire, 100 ohm RTD based on a "Din Curve". Two separate temperature signals shall be individually transmitted to the BTU computer via separate wiring. Accuracy of the system shall be + 0.5°F. or + 0.1% of the measured temperature. Temperature measurements using gas or mercury filled bulbs will not be allowed for BTU calculations
3. Manufacturer shall be Minco and sensor range will match the medium that it will measure.
4. Duct (single point) Temperature:

    a. Temperature Monitoring Range: +20/120°F (-7°/49°C).
    b. Output Signal: Changing resistance.
    c. Accuracy at Calibration Point: ±0.5°F (+/-0.3°C).

5. Duct Average Temperature:

    a. Temperature Monitoring Range: +20° ±120°F (-7°/+49°C).
    b. Output Signal: 4 – 20 mA DC.
    c. Accuracy at Calibration Point: ±0.5°F (±03°C).
    d. Sensor Probe Length: 25' L (7.3m).

6. Outside Air Temperature:

    a. Temperature Monitoring Range: -58°±122° F (-50ºC to +50ºC).
    b. Output Signal: 4 – 20 mA DC.
    c. Accuracy at Calibration Point: ±0.5°F (+/-0.3°C).

D. Liquid Differential Pressure Transmitter:

1. Ranges:

    a. 0-5/30 inches H20.
    b. 0-25/150 inches H20.
    c. 0-125/750 inches H20.
    d. 0-30 psi.
    e. 0-50 psi.

2. Output: 4 – 20 mA DC.
3. Calibration Adjustments: Zero and span.
4. Accuracy: ±-0.2% of span.

5. Linearity: ±-0.1% of span.
6. Hysteresis: ±-0.05% of span.

E. Differential Pressure:

1. Unit for fluid flow proof shall be Penn P74.
2. Range: 8 to 70 psi.
3. Differential: 3 psi.
4. Maximum Differential Pressure: 200 psi.
5. Maximum Pressure: 325 psi.
6. Unit for air flow shall be Siemens Building Technologies SW141.
7. Set Point Ranges:

    a. 0.5" WG to 1.0" WG (124.4 to 248.8 Pa).
    b. 1.0" WG to 12.0" WG (248.8 to 497.6 Pa).

F. Static Pressure Sensor:

1. Range:

    a. 0 to .5" WG (0 to 124.4 Pa).
    b. 0 to 1" WG (0 to 248.8 Pa).
    c. 0 to 2" WG (0 to 497.7 Pa).
    d. 0 to 5" WG (0 to 1.2 kPa).
    e. 0 to 10" WG (0 to 2.5 kPa).

2. Output Signal: 4 – 20 mA VDC.
3. Combined Static Error: 0.5% full range.
4. Operating Temperature: -40º to 175º F (-40C to 79.5ºC).

G. Air Pressure Sensor:

1. Range:
    a. 0 to 0.1 in. water (0 to 24.9 Pa).
    b. 0 to 0.25 in. water (0 to 63.2 Pa).
    c. 0 to 0.5 in. water (0 to 124.5 Pa).
    d. 0 to 1.0 in. water (o to 249 Pa).
    e. 0 to 2.0 in water 90 to 498 Pa).
    f. 0 to 5.0 in. water (0 to 1.25 kPa).
    g. 0 to 10.0 in. water (0 to 2.49 kPa).

2. Output signal: 4 to 20 mA.
3. Accuracy: ±1.0% of full scale.

H. Humidity Sensors:

1. Range: 0 to 100% RH.
2. Sensing Element: Bulk Polymer.

3. Output Signal: 4 – 20 mA DC.
4. Accuracy: At 77°F (25ºC) ± 2% RH.

I. Pressure to Current Transducer:

1. Range:

   a. 3 to 15 psig (21 to 103 kPa) or
   b. 3 to 30 psig (21 to 207 kPa).

2. Output Signal: 4 – 20 mA.
3. Accuracy: ± 1% of full scale (± 0.3 psig).
4. All automatic temperature control valves in water lines shall be provided with Characterized throttling plugs and shall be sized for minimum 25% of the system pressure drop or 5 psi, whichever is less.

   a. Two position valves shall be line size.

J. Electric Damper Actuators:

1. Electric control shall be Siemens Building Technologies OpenAir™ direct coupled actuators on dampers with an area of less than 5 sq ft.
2. Electric Damper actuators shall be Brushless DC Motor Technology with stall protection, bi-directional, all metal housing, manual override, independently adjustable dual auxiliary switch.

   a. For parallel fan isolation damper actuators, provide fail safe spring return closer.
   b. The actuator assembly shall include the necessary hardware and proper mounting and connection to a standard ½" diameter shaft or damper blade.

3. Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.
4. All actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator's output coupling with the damper shaft. The self-centering clamp shall have a pair of opposed "v" shaped toothed cradles; each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with the damper shaft.
5. All actuators having more than a 100 lb-in torque output shall accept a 1" diameter shaft directly, without the need for auxiliary adapters.
6. All actuators shall be designed and manufactured using ISO9000 registered procedures, and shall be Listed under Standards UL873 and CSA22.2 No. 24-93 l.
7. Actuator Accessories: Equip each unit with visible position indicators, 125% torque rating (over application torque demand), go second stroke-cycle adjustable stroke stops, installation hardware, positive feedback positioners, and adjustable start and operating ranges, and for parallel fan isolation dampers provide spring return to "failsafe" position.

2.10 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on the maximum pressure and temperature rating of the piping system, valves shall fail in the closed position unless otherwise indicated.

B. NPS 2 and Smaller:

1. Glove Valve,Bronze body, bronze, or 316 SS trim, rising stainless steel stem, renewable compositiondisc, and screwed ends.
2. Characterized port Ball Valve: Bronze body, SS ball.

C. Globe Valves: NPS 2-1/2 and Larger shall not be used.

D. Characterized port Ball Valves: NPS 1½ and Larger: Iron Body, stainless steel trim, flanged ends, renewable internal components.

E. Hydronic system: globe or ball valves shall have the following characteristics:

3. Rating: ANSI Class 150.
4. Internal Construction: Replaceable plugs and seats of stainless steel, bronze, or Monel. Globe valves shall be single seated.
5. Sizing: 3-psig maximum ensure valve selection Cv for a head/pressure loss of 10 feet, 50% of coil pressure drop at design flow rate, or 20% of system ΔP, whichever is greater.
6. Flow Characteristics: Two-way valves shall have equal percentage characteristics; threeway valves shall have linear characteristics. Operators shall close valves against pump shutoff head pressure – minimum 100 psig for central plant chilled water applications. Three-way valves are prohibited in the chilled water system. Use of three-way valves in heating water systems shall be limited to end-of-run installations as approved by the University during the design.
7. Leakage rate shall be 0.1% of rated valve flow coefficient (C_v) for soft-seated valves and 0.5% for metal-to-metal seated valves.
8. Turndown ratio: 100:1.
9. Large Valves: For flow rates greater than 100 GPM, valves shall be characterized port ball type as manufactured by Fisher, Samson Controls or Valtek.

G. Steam System Control Valves: The University main campus does not distribute steam for general heating purposes. Control valves shall be packaged by the equipment manufacturer and fully compatible with the steam system where they are installed (e.g. cage washer booster heater). Work in the University's Central Generating Facility is special construction and is not covered by this section.

H. Terminal Unit Control Valves: Bronze body, bronze or PTFE trim, replaceable plugs and seats, threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head or 100-psig. Positioners are not required.
3. Flow Characteristics: Valves shall have equal percentage characteristics.
4. Actuators: Actuator shall provide visual indication of valve position if electronically actuated.

5. Type: Terminal unit valves may be globe or characterized-port ball valves.
6. Manufacturers: Siemens, Griswold, or equal.

I. Two-position Isolation valves: Where indicated, provide motor operated gate valves for isolating hydronic boilers and steam boilers.

5. Gate valves shall be OS&Y, Iron-body, bronze-mounted. Actuators shall be AUMA.

2.12 MISCELLANEOUS DEVICES

A. Thermostats:

1. Room thermostats shall be of the gradual acting type with adjustable sensitivity.
2. They shall have a bi-metal sensing element capable of responding to a temperature change of one-tenth of one degree. (Provide all thermostats with limit stops to limit adjustments as required.)
3. Thermostats shall be arranged for either horizontal or vertical mounting.
4. In the vertical position thermostat shall fit on a mullion of movable partitions without overlap.
5. Mount the thermostat covers with tamper-proof socket head screws.

B. Fan Inlet Airflow Measuring Station (Provided by unit manufacturer):

1. Each station shall contain total and static pressure sensing manifolds, internal piping and external pressure transmission ports with flexible tubing and quick-connect fittings. Fabricate of galvanized steel, size for fan inlet in which mounted. Maximum pressure loss through station of 0.08 inches water gage at 1500 fpm. Station shall have accuracy of 2%. Identify by model number, size, area, and specified airflow capacity.

C. Current Sensing Relay:

1. Provide solid-state, adjustable, current operated relay. Provide a relay which changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.
2. Adjust the relay switch point so that the relay responds to motor operation under load as an "on" state and so that the relay responds to an unloaded running motor as an "off" state. A motor with a broken belt is considered an unloaded motor.
3. Provide for status device for all fans and pumps.

D. Occupancy Sensor: Dual technology, motion and passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment, for flush mounting. Occupancy sensor provided and mounted by Division 26 where required.

E. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23 to 130 deg F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted. May be combined with space temperature sensor.

F. Room Thermostat Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed in public multiuse areas and exposed in private offices or limited user areas.
2. Set-Point Indication: Concealed for concealed set-point adjustment and exposed for exposed set-point adjustment.
3. Thermometer: Concealed for concealed setpoint adjustment and exposed for exposed set-point adjustment. Spiral bimetal.
4. Color: White.
5. Orientation: Vertical unless architectural layout won't allow vertical installation..

G. Uninterruptible Power Supply (UPS):

1. UPS will be sized to maintain panel or computer for a minimum of 30 minutes.
2. Eaton Powerware with hardwire connection or equal.
3. 120VAC 60hz input and output power +/- 10%
4. Transfer time 0 ms.
5. 150% surge capacity.
6. 0-40°C operating temperature.

2.13 CONTROL PANELS

A. Controllers, relays, switches, etc., located in equipment rooms shall be mounted in enclosed control panels with hinged locking doors. Key locks for all panels shall be keyed alike. The enclosures will be rated, as a minimum, NEMA 1.

B. Indicating devices shall be mounted on the face of the control panel door where specified.

C. Control devices, including digital indicators, located in areas subject to outside weather conditions shall be mounted inside weatherproof enclosures rated NEMA 4x.

D. The location of each panel is to allow convenient access for maintenance. Panels shall be mounted in equipment rooms, not in offices or public access areas.

E. Nameplates of engraved plastic or metal describing the function of the device shall be permanently attached beneath each panel mounted control device.

F. Power supply shall be dedicated circuit. Provide locking circuit breaker and label breaker "ATC Panel in Room No. xxx."

G. All HVAC major equipment (para. 2.5) control panels, not application specific or floor level controllers, Siemens MEC, MBC panels or Johnson Controls NAE, NCM, DX 9100 panels as specific examples will require 30 minutes back up power on an uninterruptible power supply.

2.14 CONTROL CABLE

A. Minimum wiring shall be 20 gage Belden 9154 twisted shielded pair or equivalent with different color code selection. Color-code 24 VDC wiring: black is negative and white is positive.

B. Exposed wiring in equipment rooms and inside walls (both line and low voltage) shall be routed in conduit, wire or cable trays. Installation shall be square with the walls of the buildings.

C. Above accessible ceilings, low voltage conductors may be UL listed plenum cable. Install the cable parallel to building walls.

D. In buildings with cable trays, plenum cable shall be run in the cable trays.

E. Wiring in control panels shall be neat and orderly in workmanship. Label wiring with point name.

F. Conduit run between any two interface or control panels shall be sized to provide an additional twenty-five percent of wiring capacity for future control modifications.

G. Instrument and output device wiring shall be labeled at every termination including both sides of interim splices within panels. Labels are required for wire pairs, and not for individual wires. Labels shall be installed within two inches of termination, or in the case of I/O devices around the wire jacket anywhere in the device wiring cavity within six inches of termination. Labels shall be machine printed with indelible ink on heat shrinkable plastic tubing (Brady Sleeve Wiremaker Label WMS-211-319). In no case are self-adhesive labels accepted, unless machine printed and protected with clear heat shrinkable tubing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct-, pipe-, and equipment-mounted devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

A. Install equipment level and plumb.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve sequence of operation specified.

D. Verify location of thermostats, humidistats, CO2 sensors, and other exposed control sensors with plans and room details before installation. Locate all 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.

3. Where indicated.

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor conditions without providing watertight protection. Damper actuators shall NOT be supported from or connected to ductwork. Provide structural support or connect to floor or masonry wall. Damper actuators shall move the controlled damper smoothly and without stalling or hesitation through its complete range of motion against the maximum air static anticipated without visible deflection or bending of any mounting component and without slop or play in the actuator its mounting method or points of connection to the damper.

G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC."

H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping and Valves" or “High Temperature Water Piping” as applicable.

I. Install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."

J. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

K. Install electronic and fiber-optic cables according to Division 27 Section for communication backbone cabling.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 requirements for communications, and communications backbone cabling.

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
4. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
5. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
6. Isolation dampers shall be demonstrated at maximum fan pressure showing that the actuator moves the damper smoothly through its full range of motion without hesitation or stalling and with no visible deflection of any components.

B. Engage a factory-authorized service representative to perform startup service.

C. Replace damaged or malfunctioning controls and equipment.

1. Start, test, and adjust control systems.
2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

D. Verify DDC as follows:

1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
2. Verify operation of operator workstation.
3. Verify local control units including self-diagnostics.
4. Verify operation of controls at Central Plant and HVAC Shop workstations.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain control systems and components.

1. Train University's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 40 hours' dedicated instructor time on-site.
3. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data."
4. Schedule training with University, through University's Representative. Refer to Division 01 Section "Demonstration and Training.".

3.7 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by University's Representative, to adjust and calibrate components and to assist University's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.8 POINTS LIST

A. The DDC shall be capable of the minimum following points for the indicated system.

1. 100% Outdoor Air Units:

    a. Supply fan status and alarm.
    b. Start/stop/auto operation of fan(s).
    c. Air flow in cfm, from flow measuring station.
    d. VFD drive speed, from communications link.
    e. Coil(s) or supply air discharge temperature.
    f. Control valve positions.
    g. Outside air temperature (typical).
    h. Downstream static pressure.
    i. Motor current, from VFD communications link.
    j. Fault status of variable frequency drive (VFD).
    k. High static pressure alarm.
    l. Smoke detector alarm.
    m. Isolation dampers.

2. Recirculating AHUS:

    a. Supply and return fan status and alarm.
    b. Start/stop/auto operation of fan(s).
    c. Air flow in cfm, from flow measuring station.
    d. VFD drive speed, from communications link.
    e. Mixed and return air temperature.
    f. Coil(s) discharge temperature(s).
    g. Control valve positions (heating and cooling).
    h. Downstream static pressure.
    i. Motor current, from VFD communications link.
    j. Fault status of variable frequency drive (VFD).
    k. CO2 return air in ppm or in the room where the occupant load is 40 sq. foot per person or below.
    l. CO2 outside air intake in ppm.
    m. High static pressure alarm.
    n. Smoke detector alarm.
    o. Outside air, return and relief dampers, and position.
    p. Isolation dampers (at paired units only).

3. Lab Exhaust Fans:

    a. Fan status (on/off/alarm).
    b. VFD drive speed, from communications link.
    c. Duct static pressure.
    d. Fault status of variable frequency drive (VFD).
    e. Motor current, from VFD communications link.
    f. Isolation dampers.
    g. Bypass dampers.

4. Pumps:

    a. Pump status (on/off/alarm).
    b. VFD drive speed, from communications link.
    c. Downstream static pressure.
    d. Differential pressure and pressure ranges.
    e. Fault status of variable frequency drive (VFD).
    f. Motor current, from VFD communications link.

5. Domestic Hot Water Circulating Pumps:

    a. Pump status (on/off/alarm).

6. Heat exchangers and Water Heaters:

a. Heating water supply and return temperature.
b. Control valve, and position.
c. Pump status.
d. Supply and return temperatures for Domestic Hot Water and HHW return temperature.
e. Supply and return temperatures for Industrial Hot Water and HHW return temperature.

7. CHW system:

a. CHW flow meter.
b. Supply and return temperature sensors.

8. Steam system:

a. Steam flow meter.
b. Steam pressure and Temperature sensors (supply and return).
c. Steamcontrol valve, and valve position.

9. Terminal units:

a. Terminal unit cfm.
b. Room temperature.
c. Thermostat set point temperature.
d. Downstream supply air temperature.
e. Reheat coil valve, and position.
f. Connection to occupancy sensor relay.

10. Process Cooling Water system:

a. See detail on plans for system requirements, and system alarms.

11. Building system functions:

a. Building exhaust fans (start/stop/status).
b. Domestic Cold Water volume metering.
c. Natural gas volume metering.
d. Cold room temperature/common trouble alarm.
e. Steam heat exchanger alarm: (2) temperature sensors (for redundancy), in Heating Hot Water system for high water temperature alarm notification, valve closure, and pump off.
f. All VFD's: Fault status of variable frequency drive (VFD).
g. Lab Controls panel trouble alarms.
h. Fan Coil space setpoint and high temperature alarm.
i. Sump pump high-level alarms.
j. Lab air low pressure alarms.
k. Lab vacuum pump pressure alarms.
l. Emergency generator alarm, fuel oil tank level and leak monitor alarms.

m. Emergency generator status (on/off).
n. Automatic Transfer Switch; position, and common trouble.
o. Liquid sensors (transformer vaults/rooms).
p. Outdoor air temperature, humidity, and enthalpy.
q. Water Softener and RO Producer common trouble alarms.
r. Sewage/Storm Ejector High Level Alarms.
s. Condensate Pump alarm.
t. Oxygen Monitor/Sensors – common alarm.

12. Atrium Smoke Purge System:

a. See detail on plans for system requirements, and system alarms.

END OF SECTION 23 0900

SECTION 23 0993 – CONTROL SEQUENCES – GENERAL AND AIRSIDE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 specifications, apply to this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to Section 230900 – Instrumentation and Control for HVAC.

PART 3 - EXECUTION

3.1 GENERAL

A. This section is a supplement to the control diagrams on the drawings. The control diagrams generally indicate control devices as well as some desired logic. This section provides the basis for the sequences of operations, the control logic, device location clarification, measurements, as well as the general intent of the outcome for the control systems.

B. The Execution Section Paragraphs are arranged in an alternate way to improve the clarity of the intent by avoiding duplication and repetition of the requirements common to multiple systems.

C. The abbreviations AFD, ASD, and VFD are used interchangeably and all represent the same adjustable speed drive controller for a motor.

3.2 POST-OCCUPANCY CONTROLS OPTIMIZATION REQUIREMENTS

A. After owner occupancy, the heating and cooling loads will dramatically change from when the control systems were initially set up in an empty building due to the owner's use of the building. The owner's actual occupancy of the building will also be slightly different from his initial programming assumptions shown on the design drawings. Optimization/alteration of the control system initial set-up will be required to meet the owner's specific occupancy.

B. The controls contractor, together with the mechanical contractor and TAB contractor are responsible for optimizing and dialing in the performance of the systems to meet the needs of the owner's occupancy conditions. The plans and specs require basic elements of adjustability (automatic and manual) to be provided in the vendor's proprietary controls systems. The

controls contractor is the expert in his installed control systems and shall optimize and adjust many theoretical design setpoints to accommodate the as-built equipment and system conditions (which vary from the theoretical design assumptions) and the owner's actual occupancy.

C. After the owner has moved in, the controls contractor shall be responsible to optimize the operation, setpoints, and control logic for the as-built systems to alleviate owner comfort or operational complaints.

D. Prior to providing troubleshooting guidance, the engineer reserves the right to request documented validation of system set-up sign-off sheets, printouts of actual control software code, control data trends for suspected problem areas, re-TAB of suspected problem areas, and documentation of contractors self-troubleshooting efforts. It is the contractors burden to provide written documentation to the engineer to prove the systems are installed and set up according to the design intent.

3.3 GENERAL REQUIREMENTS FOR ALL SYSTEMS:

A. CONTROLLER POWER: The power for equipment control panels shall be powered from the line side of the starter for the equipment controlled or from a separate circuit (by Div. 23) so that the controller will continue to have power and will stay on the BAS network when the unit is turned off or is off due to failure.

B. EMERGENCY POWER: If the equipment being controlled is on emergency power, then the controller must be on emergency power also.

C. CONTROL DEVICE POWER: The basis for control and monitoring of all actuators and control devices is to use low voltage 24V power. The controls contractor shall provide low voltage wiring for all controls. Since different controls contractors would execute the control wiring in different ways, the project documents do not include locations for source 120V power to feed the 24V power wiring – that task shall be the responsibility of the successful controls contractor. The controls contractor shall coordinate with the electrical contractor and compensate the electrical contractor for desired quantities and locations for 120V power sources to feed their low voltage system design.

D. 24V DAMPER AND VALVE ACTUATORS: The basis of design is for 24V low voltage actuators for all air-side dampers and water side valve actuators. The intent is for the controls contractor to have exclusive responsibility for installation and operation of all control systems – including the smoke and fire-smoke dampers.

E. SCHEDULES: The schedules shall be based upon a 24 hour, 365day calendar with exception days and holidays.

1. For multi building facilities provide four levels of scheduling. They shall be Area, Group, Building, and Unit. Units will be assigned into buildings, buildings into groups, and groups into areas. Each piece of equipment shall reference all of these schedules and if any of them are occupied, the equipment shall go into occupied mode.
2. For single building facilities provide four levels of scheduling. They shall be Building, Floor, Wing, and Unit. Units shall be assigned to wings, wings into floors, and floors into buildings. Each piece of equipment shall reference all of these schedules and if any

of them are occupied, the equipment shall go into occupied mode. If the building does not have multiple floors or wings, then those respective schedules may be eliminated.

F. ACTIVE SET POINTS: The control sequences shall reference active cooling and heating analog values. These values shall be set to the occupied set points during occupied mode and the unoccupied set points in unoccupied mode.

G. PRE/POST OCCUPANCY MODES: Each piece of equipment and system shall have pre and post occupancy variables to indicate how many hours before and after occupancy the equipment shall operate in pre/post occupancy mode. In pre/post occupancy mode, the equipment shall use occupied set points but shall use either no outside air or alternate ventilation rates.

H. ACTUATOR FEEDBACK: Provide BAS monitoring of position feedback of valve and damper actuators. The purpose for this requirement is for user identification of malfunctioning actuators at the BAS front end graphic screens, and to assist in commissioning, and to reduce the troubleshooting time schedule. End switches are not an acceptable method of monitoring partial positions. An actuator feedback alarm shall be generated if the position feedback differs from the commanded position by more than 15% for 5 minutes. Graphic points shall include the following for each actuator:

a. Commanded Position.
b. Position Feedback.
c. Feedback Alarm

I. PID LOOP TUNING: It is expected that the controls technicians shall provide PID loop tuning for the various controlled systems to avoid overshooting and oscillation. At the minimum Proportional gain and the Integral time values shall be adjusted based upon device manufacturers recommendations, and the control technicians shall be able to discuss their P and I values with the engineer and commissioning authority. Common P&I values can be used for similar groups of devices (such as all supply VFD's or all 2-way HW control valves, etc). Derivative time should be 0 or off for most HVAC control loops. Only high reaction speed control loops, such as in laboratories and clean rooms, shall include D values. Small reheat valves are particularly subject to hunting, so loop tuning shall be included for those devices.

J. VARIABLE FREQUENCY/ADJUSTABLE SPEED DRIVE CONTROL AND MONITORING: The basic specification for VFD equipment requires a CAT 5 connection to the control system. The controls contractor shall incorporate the VFD's manufacturer's data format to at least display the internal set-up values (generally in the range of 50-100 data points) and operating values if the operator chooses to observe the operation of a VFD on a separate graphics/data screen. The basic VFD operating data described in subsequent sections shall be provided on the related equipment graphics screen. Providing the operator the ability to quickly evaluate and troubleshoot a VFD and related motor from the BAS front-end is a high value feature since improperly operating VFD's can waste large amounts of unnecessary energy, and of course comfort complaints.

K. ALARM PRIORITY: The BAS shall provide alarms in a logical manner to assist the facility operator in prioritizing alarms. Alarm tags shall include the point name, general equipment name, priority level, and alarm description. For example: KRMC:P07:AHU07_CCTEMP, AHU-7 Cooling Coil Temperature Sensor, Medium Priority, High leaving air temperature 5F

above set point. Prioritize alarms based upon the following criteria. Submit alarm priority to engineer for review.

High Priority – equipment failure, freezing, over heating, etc.
Low Priority – high/low temperatures, pressures, dirty filters, diagnostics, etc.

L. Provide function to delete all alarms from the print queue manually if desired. Provide function to sort alarms by priority and print alarms by priority. Provide a graphic page to view both priority alarms. Provide a local error message link in the lower corner of the graphic display of the AHU to display just error messages associated with the pieces of equipment displayed in the graphic page.

High Priority Alarm List. Provide a link to display the last 10 high priority alarm messages associated with the piece of equipment.
Low Priority Alarm List. Provide a link to display the last 10 low priority error messages.

M. CURRENT TRANSDUCER (CT) PROGRAMMING LOGIC: All new constant speed fan motors and pumps shall have analog current transducers (CT) which provide a continuous amp draw signal. The normal amp draw for each constant speed motor shall be recorded and stored AFTER test and balancing is complete. Program a high limit alarm when current is 25% higher than "normal" for 5 minutes. Program a low limit alarm when current is 50% of "normal" for 5 minutes. The low limit shall be used for proof of flow. If amp draw is below low limit then either flow is very low, or a fan belt broke.

N. PREDICTIVE MAINTENANCE TRENDING GRAPH: For all fixed speed motors with analog current transducers, continuously calculate a 30 day average of motor amp draw (record amp draw only when motor is on). Compare the actual motor amp draw with the 30 day average. If the actual amp draw is 10% higher (adjustable) than the 30-day trailing average, then provide a low level alarm for "high motor amp draw – anticipate failure". A high amp draw is a prediction of motor or bearing failure.

O. EMERGENCY POWER SOURCE. If only selected equipment and systems are to run on emergency power, then the power source for those control devices shall originate from emergency power.

P. HOT AND CHILLED WATER EMERGENCY POWER. If only portions of the hot or chilled water systems are intended to operate during emergency power, then spring-return closed valves shall be used on non-emergency powered water valve actuators. This is to direct the water to only the intended usage. Fewer branch line spring-return closed isolation valves can be substituted for many coil valves.

3.4 GRAPHIC DISPLAYS AT OPERATOR INTERFACE

A. Create graphical display pages for the equipment and systems on the project, including but not limited to the following. Refer to other paragraphs for specific requirements for data points.

1. Air handling/Rooftop units

2. Building Central Systems – including (chilled water booster pumps, hot water heating systems including steam to HHW heat exchanger systems, Process Cooling System including chilled water to process cooling water heat exchangers and pump systems, etc)
3. VAV box summary table (see description)
4. Reheat coil summary table (see description)
5. Air filter summary table (see description)
6. Fan coil units
7. Supply and exhaust fans
8. Smoke control systems

B. Provide floor plan graphic screens which represent the location of the equipment, for click-through of that equipment.

C. Floor plans shall also include data points for space temperature setpoints and measured values. Each room on the floorplan shall be mapped to a color coded reference chart which displays the measured room temperature in color. There shall be two color coded temperature maps for the floorplans – the first for measured temperature, and the second for difference between the temperature setpoint and the measured temperature. The color code shall be darker blue for cooler rooms, yellow for comfortable rooms, and orange/red for progressively warmer rooms. The same color scheme of shades of blue for colder rooms and shades of red for warmer rooms shall be used for the differential temperature map of the difference between setpoint and actual measurement temperature.

D. Provide a link on each graphic page to the written sequence of operations for that system or piece of equipment.

E. Provide a time/date stamp on the graphic display so it will be shown when captured and printed.

F. Provide a graphical representation for each piece of equipment controlled. Display all sensor points in appropriate locations to the actual placement of the sensors. Provide on/off/position indications for motors, actuators, etc. Display the set points for various control loops adjacent to the actual sensor readings, such as supply air temperature set point and actual temperature, pre-heat coil temperature set point and actual temperature, etc. If the control loop is 'off', such as pre-heating, then show 'off' in the set point display box. Provide a direct link to a floor plan of the building with the area served by the AHU highlighted. Provide a direct link to the Filter Status page.

G. For each piece of equipment, provide a photo-link to a digital photo (or multiple photos for larger pieces of equipment) of the piece of equipment shown in the graphical display.

H. Provide a "Maintenance" screen link to each piece of equipment and system which allows the Owner to input and manage maintenance related items for each piece of equipment. The Maintenance screen shall include data fields for the owner to input make/model numbers for items such as fan belts, motor sizes, filter sizes and quantities, oil type, etc., as well as date field for recording servicing dates.

I. The graphic screen development for equipment and systems shall include displayed data points for the values listed in the various paragraphs. When a particular equipment graphic screen gets too cluttered, it is acceptable that a second page be utilized for the displaying of the non-critical (but still required and desired) data points. In all cases where there is a setpoint variable used in

a control algorithm, the associated measured value shall also be displayed to provide the operator with a visual indication of the accuracy of the PID control loop operation.

3.5 PACKAGED EQUIPMENT CONTROLS INTERFACE

A. It is common for project equipment from manufacturers to have self-contained controls and microprocessor logic such as packaged steam boilers skids, container type humidifiers, some VAV boxes, etc. The self-contained equipment's controls should be 'connected' and integrated into the overall control system for the project. Internal data points related to operation should be pulled from the self-contained control system so that the operator can view operating data points. And key adjustable operating setpoints such as temperatures and pressures should be able to be input into the self-contained equipment's control system.

B. If equipment substitutions are made, then the equipment's self-contained control package should include the control logic and sequence capabilities described in the subsequent paragraphs. Not all features will be available from all manufacturers, which means the controls contractor may have to provide supplementary control logic on stand-alone controllers to meet the sequence of operations design intent.

3.6 VARIABLE FLOW EQUIPMENT IN PARALLEL

A. When variable flow fans or pumps are arranged for parallel flow, the variable speed drives for those motors shall be synchronized to run at the same speed.

B. For parallel fans and pumps, the operating pressure setpoint logic shall be determined in multiple equipment level controllers, or in a separate wall-mounted controller. Turning off one AHU, fan or pump for maintenance shall not interrupt the variable speed of the remaining units. Daisy-chaining from one variable speed drive to another is not acceptable since turning off the lead drive will disrupt the signal to the downstream drives.

3.7 GLOBAL AND LOCAL CONTROL

A. The local control system is defined as the hardware and software for a piece of equipment or a sub-system to operate properly. For example, an air handling unit and associated remote temperature sensors, and static pressure sensors is considered a local control system.

B. The global control system is the overall network which connects the local control systems together, and connects them with a master controller with global oversight.

C. The local control systems shall be installed and set-up to operate properly in both stand-alone mode as well as normally connected to the global control system. During system commissioning, stand-alone operation shall be validated by disconnecting the global network connection and observing the equipment operating normally – or in a special stand-alone mode if specified.

D. If no stand-alone mode is specified, then the stand-alone mode for the equipment/system shall be the current mode of operation when the global network connection as lost.

3.8 AIR SIDE SYSTEM AND EQUIPMENT BASIC CONTROL REQUIREMENTS

A. General Requirements. The following basic features shall be included for every air handling unit, blower coil unit, and fan-coil units. These basic items are not duplicated in subsequent sections. For units without a specific device or mode, such as no heating capability, then that mode is obviously not required.

1. START/STOP. Each air handler and controls shall be enabled / disabled by the BAS. Unit controls shall operate automatically when energized.
2. NORMALLY ON/OFF. The normally OFF (disabled) status shall be: fans off, smoke dampers closed, return air damper open, outside air damper closed, chilled water valve closed, hot water valve closed. The normally ON status shall be: fans on and outside air dampers enabled, chilled and hot water valves enabled.
3. OUTDOOR AIR DAMPER ACTUATORS: All outdoor air damper actuators shall be modulating type spring return CLOSED, so they will close automatically on loss of utility or control power. 100% outdoor air units can have 2-position damper actuators, with spring return closed.
4. MINIMUM OA. The outside air volume shall be set up (with TAB) as a minimum damper position during occupied periods - along with active means of controlling the OA volume in VAV systems according to ASHRAE 62 or Title 24 requirements.
5. FIRE ALARM SHUTDOWN RELAY: A relay from the fire alarm system shall initiate a contactor in the AHU fan starter or VFD which turns off the AHU fans upon an alarm signal from the fire alarm system.
6. DUCT SMOKE DETECTORS: The Electrical division shall provide duct smoke detectors (compatible with their fire alarm system) for installation by the Mechanical. The fire alarm contractor shall be responsible to wire the devices to the fire alarm system.
7. INTERCONNECTS: Associated exhaust and supply fans shall be started and stopped through control power from the load side transformer for their respective air handling systems. If supply fan fails proof of flow, then the associated exhaust fans shall turn off, and zone smoke dampers shall lose power and spring closed.
8. OCCUPIED MODE: Provide an Occupied mode of operation for each unit. During the Occupied mode, the unit shall operate according to the listed sequences of operation, but generally the outside air damper shall be open to provide minimum outdoor ventilation and the active set points shall be set to the occupied set points. The AHU supply fans shall operate continuously in occupied mode.
9. UNOCCUPIED MODE: Provide an Unoccupied mode of operation for each AHU. In general, the outside air damper shall be closed and the active set points shall be set to the unoccupied set points. When the space temperatures exceed the unoccupied high and low limits, then the AHU shall be enabled (with the OA damper closed) until the space temperatures are met. The AHU supply fan shall not run during deadband mode between the high and low temperature limits. The unoccupied high space temperature limit should be initially set to 80F, and the low limit set to 60F. The outside air damper may open during unoccupied mode if economizer cooling is possible.
10. HEATING MODE: When the space temperature falls below the active heating set point, the controller shall enable the heating sequence. Once the temperature rises above the setpoint plus the deadband (2 degrees (ADJ)) then the unit will enter deadband mode.
11. COOLING MODE: When the space temperature rises above the cooling set point, the controller shall sequence the stages of cooling to maintain space temperature set point.

Once the temperature falls below the setpoint minus the deadband (2 degrees (ADJ)) then the unit will enter deadband mode.

12. DEADBAND MODE: In deadband mode, between a high and low setpoint, neither heating or cooling shall be enabled.
13. PRE-HEAT RESET. The pre-heat coil leaving air temperature setpoint shall be a derived value of the main unit Supply (not coil leaving) air temperature low limit setpoint (usually 54F or 55F) minus 5F. The intent is to provide a deadband between heating and cooling coil temperatures to avoid simultaneous operation, and to account for some fan reheat.

3.9 GENERAL AIR HANDLING UNIT CONTROL SEQUENCES

A. This section describes the requirements and sequences for the various components used on air handling units. Refer to the control diagrams for the layout of the various components and the related control sequences and for specific AHU sequence of operations.

B. GRAPHICS. The main graphics page for the air handling units shall include all physical equipment, virtual modes of operation, variable values, etc. Remote system data shall be pulled in and displayed along with local alarms including the following:

1. Outside air temperature from remote sensor if necessary
2. Outside air humidity from remote sensor if necessary
3. Mixed air temperature
4. Local alarms: low temperature, equipment failure, high pressure, etc.

C. RETURN AND EXHAUST FAN GRAPHICS. The speed control method is listed in another paragraph. Provide the following additional control connections: binary input for VFD alarm, analog input for VFD speed monitoring, analog input for VFD kW power consumption. The kW power consumption shall be used for proof of flow. Graphic Points:

1. Fan Start/Stop
2. VFD commanded speed
3. VFD speed feedback
4. VFD status
5. Amps/kW – Bar graph with marks identifying normal with new and loaded filters
6. Minimum RF Amps
7. Fan Proof of flow – Graphic showing fan rotating
8. Static Pressure
9. Static Pressure Set Point (Adjustable)

D. AHU COIL TEMPERATURE RESET. The main supply air temperature setpoint (leaving the AHU, not the coil) shall be the controlling temperature for heating and cooling coils in the AHU. The coil leaving temperature sensors are generally for monitoring, not necessarily control. The main supply air temperature sensor (if indicated on diagrams) and setpoint shall be used to provide control input to the coil logic. For draw-through AHU's, the cooling coil leaving air temperature scheduled on the drawings includes provisions for a few degrees of supply fan heat. So a desired 55F supply air temperature is generally achieved with a leaving cooling coil temperature of 51-53F, and the sensors should be configured to show that operation.

E. SIMULTANEOUS HEATING AND COOLING CONTROL. In most modes of operation, simultaneous heating and cooling is not necessary. It may be necessary in certain modes such as high-humidity control mode, or precision environmental control such as laboratories. Include control logic, or appropriate temperature setpoint offsets to prevent unnecessary simultaneous heating and cooling.

F. CHILLED WATER COOLING COIL. The cooling coil control valve shall be modulated by the supply air temperature logic of the air handling unit. When the supply air temperature is above the set point, modulate the chilled water valve open to maintain set point. Set point varies based upon reset schedule. Provide a minimum setpoint value to prevent the user from lowering the supply air temperature below the designed value – which results in a problem called 'low delta-T'. The CHW Return Temperature sensor leaving the coil is one of the most valuable points used for verifying proper operation, and for troubleshooting problems – it shall not be eliminated in post-bid cost reduction exercises. Graphic Points:

1. CHW Coil Leaving Air Temp
2. CHW Coil temperature setpoint (reset)
3. Pre-treated outside air temperature if applicable.
4. Supply Air Temperature
5. Supply Air Temperature Set Point
6. CHW Valve commanded position
7. CHW Valve Feedback
8. CHW Valve Feedback Alarm
9. CHW Return Temperature (leaving the coil)
10. CHW Supply Temperature (from Chiller Plant)
11. CHW Supply Set Point (from Chiller Plant)
12. Design Min CHW Delta T (usually the coil's design delta-T)
13. Low CHW Delta T Alarm (whenever the entering and leaving chilled water temperature difference is lower than the coil's design delta-T)

G. FILTER PRESSURE MONITORING: Provide differential pressure sensors (not switches) for all individual filter sections, pre and final. Observe and set clean fliter pressure drop setpoint during startup (with clean filters). The dirty setpoint shall be initially set to 2x the clean setpoint – or as otherwise listed in the equipment schedule, or as directed by the engineer. Both clean and dirty values shall be a displayed in the AHU graphic screen. Dirty setpoints shall not exceed the manufacturer's maximum pressure rating for the filters. For guidance, pre-filters usually should not exceed 0.45" (the frames will collapse), and 90%-99% filters usually should not exceed 1.3". Refer to the Filter Status Programming paragraph for more information.

1. Graphic Points:

    a. Current Filter Pressure Drop for Each Bank
    b. Dirty Limit for Each Bank
    c. Dirty Filter Alarm for Each Bank

2. Substitution requirement for DP Switches: If a post-bid cost cutting substitution of DP switches is proposed in lieu of DP sensors, then the following setup labor and costs shall be included in the substitution scope of work:

a. Field measurement of clean filter pressure drop. Calculation of 2x clean pressure drop for dirty pressure drop, in lieu of specific direction found in equipment schedules.
b. Manual set-up of pressure switch 'dirty' pressure setting using a Magnehelic gauge.
c. Hand-write with a permanent marker the pressure value (e.g. 0.45 in. w.g.) that the switch contact closure was set to on or nearby the physical switch itself.

H. TERMINAL HW REHEAT COILS. Associated downstream duct reheat coils shall be interlocked with air handler to energize reheat controls with air handler operation. Reset the supply air temperature set point to maintain space temperature. Modulate the hot water valve to maintain supply air temperature set point. Provide room sensors with occupant set point adjustment for reheat coils and limit adjustment from 66°F to 74° F. (note low temperature setting on reheat system actually saves energy because reheating is minimized). Supply air temperature set point information is utilized by the air handler controller for discharge air temperature control.

1. Graphic Points:

a. HW Valve position
b. Space temperature
c. Space temperature set point
d. Supply air temperature
e. HW supply temperature (from heat exchanger)
f. HW supply set point (from heat exchanger)

I. SUPPLY AIR TEMPERATURE RESET – TERMINAL BOX REHEAT. Provide supply air temperature reset logic control. The design supply air temperature (leaving the unit) shall be 55°F (unless directed otherwise). The reheat coils (elec or HW) will use cascade control which will calculate the desired leaving temperature from the reheat coil, and the leaving device temperature shall be recorded. The AHU supply air set point shall be reset upwards when all of the reheat boxes are calling for some reheat. to the minimum reheat coil set point for the reheat coils served by this air handling unit. The downstream terminal units shall be polled to see whether any is near full cooling. If none are in full cooling, then the supply air temperature setpoint can be raised 0.5F degree. After a 5 minute delay, the downstream terminal units shall be polled again. If one is in full cooling, then lower the supply air temperature 0.5F. If none are in full cooling, then raise the supply air temperature up 0.5F. The design supply air temperature shall be 55°F (unless scheduled otherwise) on startup, and shall be reset based upon terminal unit demand. Any space or return air humidity sensor shall override supply air reset for 30 minutes (adjustable) when the space humidity rises above the adjustable high limit set point 60% RH. Provide a reheat coil table graphics screen. Provide a check box in the reheat coil table to allow the user to include/exclude coils in the reset schedule calculation logic. Graphic Points:

1. Minimum associated reheat leaving air temperature set point enabled for control
2. Minimum associated reheat leaving air temperature set point.
3. Supply Air temperature set point. (max of 62F, min of scheduled cooling coil LAT + 2F)
4. Supply air temperature.

J. HOT WATER PRE-HEAT COIL. The pre-heating coil control valve shall have a setpoint which can be modulated by the supply air temperature logic of the air handling unit. The pre-heat coil discharge temperature setpoint shall be initially calculated to be the cooling coil leaving air temperature setpoint minus 5F (52F – 5F = 47F). The pre-heat temperature setpoint shall then be adjusted up or down based upon the supply air temperature reset logic. Maintaining a temperature offset will prevent simultaneous pre-heating and cooling. The user should not have to adjust the pre-heat setpoint, it should be managed entirely by the offset from the supply air reset logic. In ECONOMIZER mode, the pre-heat coil shall be Off. The pre-heat coil shall have low limit freeze prevention logic to engage the pre-heat coil valve to maintain >40F during all modes of operating including Economizer, a low level alarm shall alert the operator that a low temperature problem exists. The HW Preheat Return Temperature sensor leaving the coil is one of the most valuable points used for verifying proper operation, and for troubleshooting problems – it shall not be eliminated in post-bid cost reduction exercises. Graphic Points:

1. HW Pre Heat Coil Leaving Air Temp
2. HW Pre Heat Coil Setpoint (reset)
3. Supply Air Temperature
4. Supply Air Temperature Set Point
5. HW Valve commanded position
6. HW Valve Feedback
7. HW Valve Feedback Alarm
8. HW Return Temperature (leaving the coil)
9. HW Supply Temperature (from heat exchanger)
10. HW Supply Set Point (from heat exchanger)
11. Design HW Delta T
12. Low Limit Temperature Alarm (>40F)

K. HOT WATER RE-HEAT COIL. The re-heating coil control valve shall have a setpoint which can be modulated by the supply air temperature logic of the air handling unit, or by a space temperature sensor if it is a single zone unit. The re-heat coil discharge temperature setpoint shall be reset by the supply air temperature reset logic. (if the re-heat coil is the last process, then the re-heat temperature and the supply air temperature values would be the same.) The re-heat temperature setpoint shall then be adjusted up or down based upon the supply air temperature reset logic (or space sensor). There may be a high humidity limiting control logic mode which over-cools for moisture removal – in that mode the re-heat coil would be enabled to operate normally by the supply air temperature setpoint (to prevent overcooling). The user should not have to adjust the re-heat setpoint, it should be managed entirely by the offset from the supply air reset logic, or the space setpoint. In ECONOMIZER mode, the re-heat coil shall be Off. The HW reheat Return Temperature sensor leaving the coil is one of the most valuable points used for verifying proper operation, and for troubleshooting problems – it shall not be eliminated in post-bid cost reduction exercises. Graphic Points:

1. HW Re Heat Coil Leaving Air Temp
2. HW Re-heat coil temperature setpoint (reset)
3. Space temperature (if single zone unit).
4. Supply Air Temperature (can serve as reheat coil discharge sensor too if it the last device)
5. Supply Air Temperature Set Point

6. HW Valve commanded position
7. HW Valve Feedback
8. HW Valve Feedback Alarm
9. HW Return Temperature (leaving the coil)
10. HW Supply Temperature (from heat exchanger)
11. HW Supply Set Point (from heat exchanger)
12. Design HW Delta T

L. ECONOMIZER MODE: Provide control logic to mix the OA and RA to the supply air temperature reset value to minimize mechanical cooling, using a Mixed Air temperature sensor and setpoint reset. A comparative dry bulb temperature switch is generally used to turn on/off the economizer mode. Economizer mode shall be enabled when the OA dry bulb temperature is less than the RA dry bulb temperature. The mixed/return air and OA damper actuators shall operate inversely. As the mixed air temperature drops, the OA damper shall modulate from open to the minimum ventilation position. When the minimum ventilation position is reached, then Economizer mode can be turned Off to allow the pre-heat coil to operate normally. Relief may or may not be actively controlled. In some arid regions, the contractor may substitute dry bulb temperature comparative dry bulb temperature control methods for review and approval. Ensure the temperature/humidity sensors for the enthalpy controller are in locations with active airstreams to continuously measure differences between the OA and RA conditions. Graphic points:

1. Economizer Mode on/off (based upon comparative enthalpy switch)
2. Economizer dry bulb temperature values if approved for temperature control
3. Mixed Air temperature setpoint, based upon offset from Supply air temperature reset value.

M. OCCUPIED MODE. When indexed to the occupied mode (either automatically, or manually overridden) the supply air fan shall be enabled and the various components of the AHU shall be enabled. In occupied mode the OA damper should be enabled Open to bring in ventilation air for the occupants.

a. Heating Mode – When the space temperature falls below the heating set point, the controller shall sequence the stages of heating to maintain space temperature set point.
b. Cooling Mode – When the space temperature rises above the cooling set point, the controller shall sequence the stages of cooling to maintain space temperature set point.
c. Dehumidification Mode – When the space humidity exceeds the high humidity limit of 60%, then dehumidification model shall be enabled. Dehumidification mode shall operate until the relative humidity drops below 56% or after 30 minutes. There shall be a 10minute time delay before the system can re-enter dehumidification mode. Dehumidification mode is essentially lowering the cooling coil leaving temperature to its lower design point to remove moisture from the airstream, thereby lowering the space relative humidity. The control logic may include stages of heating to prevent overcooling the space – which drives up the relative humidity even farther.
d. High and Low Occupied Temperature Setpoints. The space setpoints are generally user adjustable within a pre-defined range of temperatures – for normally occupied

spaces. Initially limit user adjustability between a low of 72F and a high of 78F. After occupancy, it is expected that some of the sensors limits will need to be adjusted. For normally unoccupied spaces such as electric rooms, provide a higher high limit of 80F.

N. UNOCCUPIED MODE. When indexed to the unoccupied mode (either automatically, or manually overridded), the supply fan shall be disabled and the unit shall essentially shut down. Ensure all OA/relief dampers and smoke/isolation dampers are closed

a. Heating Mode – When a space temperature falls below the unoccupied space temperature heating set point, the supply air fan shall be enabled. The various modes of heating shall be enabled to achieve the unoccupied space temperature set point. The outside air damper shall remain fully closed and the return air damper shall remain fully open.
b. Cooling Mode – When the space temperature rises above the unoccupied space temperature cooling set point, the supply air fan shall be enabled. The stages of cooling shall be enabled to achieve the unoccupied space temperature set point. The outside air damper shall remain fully closed and the return air damper shall remain fully open.
c. High and Low Unoccupied Temperature setpoints. The AHU shall be off when the space temperatures are in the deadband between the High and Low temperature setpoints. When the temperature exceeds the High and Low setpoints – the AHU shall be enabled with the intention of serving only the outlying space if possible. The High and Low Unoccupied space temperature setpoints shall be adjustable, and shall initially be set to the following for normally occupied spaces:

1) High: 80F occupied space.
2) Low: 60F

O. DEHUMIDIFICATION MODE. When return air (or space) humidity sensor reads above high humidity setpoint of 60% (adjustable, but limited between 55% and 70%, unless specified otherwise for a special space)), then the supply air temperature reset shall be reset back to the design setpoint (typically 55°F), and the supply air temperature reset logic shall be disabled for 30 minutes (adjustable). Graphic Points:

1. Dehumidification mode status.
2. Humidity reading of space and return humidity sensors.
3. Supply Air temperature reset set point.
4. Supply air temperature.
5. Dehumidification mode timer status.
6. High humidity setpoint (limit user adjustability between 60% and 70%)
.

P. FIRE ALARM SHUTDOWN. Electrical shall provide an addressable fire alarm shut down relay to be installed in the AHU starter control circuit which shuts down the AHU on a call from the fire alarm system. When the fire alarm system commands the AHU to shut down, associated smoke dampers shall lose power and spring return close, and associated exhaust fans shall turn off.

Q. DUCT SMOKE DETECTORS. Duct smoke detectors compatible with the fire alarm system shall be furnished by Electrical. Install duct smoke detectors in the supply and return duct (prior to any branch ducts) of air handling units with capacity greater than 2,000 cfm, or as required by local code.

R. FREEZE PROTECTION – FREEZESTAT. A low temperature cutoff type switch shall be used to stop the fan when the serpentine sensing element senses temperatures below the setpoint. The setpoint shall initially be 35°F. The device shall be manually reset. The sensing element shall not be less than one linear foot per square foot of coil surface area. The sensing element shall be installed on the downstream side of the coil.

S. FREEZE PROTECTION – SOFT PROTECTION. When any water coil leaving air temperature sensor detects a temperature below 40°F, then the outside air damper shall close, the water valve shall open, and send a high priority alarm. If the air temperature is below 35°F for more than 15 minutes, then disable the air handling unit, and send a high priority alarm. Graphic points:

1. Freeze protection status (normal, soft protection mode, shutdown mode).
2. Freeze protection alarm.

T. TRENDING. Set up the following trends for the AHUs. For each trend group, provide trend durations as indicated.

1. Temperature Performance. Daily and Monthly. Store data collected every 30 minutes (adjustable). Ensure data storage device is large enough to handle at least 2 years of data collection.

    a. Outside air temperature
    b. Return air temperature
    c. Mixed air temperature
    d. Return air humidity, or space humidity
    e. Pre-heat coil leaving air temperature
    f. Cooling coil leaving air temperature
    g. Supply air temperature
    h. Supply air temperature reset value

U. ALARMS. Provide low priority alarms for the following items in addition to the standard high and low priority alarms listed in the alarm requirements.

1. ‘Low supply duct static pressure.’ When the fan is On and the measured supply duct static pressure is more than 0.2” below the setpoint for more than 30 minutes.
2. ‘Low chilled water return temperature’ when the coil leaving chilled water temperature is below 52°F for more than 30 minutes, and the cooling coil is enabled. (this is a low delta-T prevention alarm)
3. ‘High leaving chilled water temperature’ when the leaving chilled water temperature is higher than 64°F for more than 30 minutes, and the cooling coil valve is enabled. (this is preventive maintenance alarm that either the coil strainer is clogged, heating is improperly enabled, or the inlet air temperatures are out of bounds)

3.10 CHW VARIABLE AIR VOLUME AHU

A. In addition to the Basic and General requirements listed in previous paragraphs, provide the items specific on the drawings for this type of operation

B. In addition, provide the following additional control connections: binary input for VFD alarm, analog input for VFD speed monitoring, analog input for VFD kW power consumption. The kW power consumption shall be used for proof of flow. Graphic Points:

1. Supply Fan Start/Stop
2. VFD commanded speed
3. VFD speed feedback
4. VFD status (alarms, etc)
5. Amps/kW – Bar graph with marks identifying normal with new and loaded dirty filters
6. Minimum SF Amps
7. Fan Proof of flow – Graphic showing fan rotating
8. Duct Static Pressure
9. Duct Static Pressure Set Point (Adjustable) (0.01 in w.g. accuracy)

3.11 CHW 100% OUTSIDE AIR AHU

A. In addition to the Basic and General requirements listed in previous paragraphs, provide the items specific on the drawings for this type of operation.

3.12 EXHAUST FANS - GENERAL

A. In addition to the Basic and General requirements listed in previous paragraphs, provide the items specific on the drawings for this type of operation.

B. The controller shall initiate an alarm under the following conditions:

C. EXHAUST FANS ASSOCIATED WITH AHU'S: When the intent is for exhaust fans in an AHU zone to balance the outside air volumes, the exhaust fan shall be enabled with the "associated" air handling unit is enabled. When its associated air handling unit is off, the exhaust fan shall be off. The controls requirement is for the exhaust fan starter control circuit to be connected to the associated AHU starter circuit – so when the AHU is turned off (either remotely or manually), then the exhaust fan's control circuit loses power and turns off too.

D. SCHEDULED OPERATION: When the exhaust fan operation is by occupancy schedule, the BAS time of day schedule and occupancy modes shall turn on and off the exhaust fans.

E. SWITCHED FANS: Provide on/off control for exhaust fans on manual switches.

F. LAB VAV EXHAUST FANS: For multiple parallel fans provide logic to control all fan speed controllers to the same signal based upon duct static pressure setpoint. Each fan shall have separate control wiring back to a remote controller – they shall not be daisy chained together so if one fails the other downstream fans fail too.

1. If there is a plenum bypass damper included for minimum airflow, provide actuator and controls for the bypass damper. Logic shall be to only open the bypass damper when the fans are at minimum speed, and the duct static pressure is above the setpoint. This will minimize exhausting conditioned space air.

G. SMOKE CONTROL EXHAUST FANS: Refer to plans.

3.13 FAN COIL UNITS - CHILLED WATER

A. GENERAL. In addition to the sequence indicated on the plans, the following paragraphs describe control sequences for independent control loops for the fan coil units. General Graphic Points include but are not limited to:

1. Occupied/Unoccupied Mode
2. Supply air temperature (refer to control diagram)
3. Space temperature
4. Space or RA relative humidity
5. Dehumidification mode
6. Space cooling temperature set point
7. Space pre- or re-heating temperature set point
8. CHW and HW Valve position (or call % for cooling)
9. Supply Fan Start/Stop
10. Fan status
11. Amps/kW – Bar graph with marks
12. Minimum supply fan Amps
13. Fan Proof of flow – Graphic showing fan rotating
14. HW Valve position (or call % for heating)

B. SAFETY DEVICES. Provide safety devices including condensate overflow switches, fire alarm shutdown if required by AHJ, duct smoke detectors if required by AHJ.

3.14 FILTER STATUS PROGRAMMING

A. Provide static pressure sensor across each pre and final filter section which provides a continuous static pressure signal.

B. Coordinate with mechanical and TAB contractor to determine ‘clean’ filter drop, and ‘dirty’ filter drop values as listed by the submitted manufacturer. Typically, the pre-filter clean and dirty pressure drops are 0.3” and 0.6” respectively. Typically, the final filter clean and dirty pressure drops are 0.7” and 1.5” respectively.

C. If the static pressure exceeds the dirty filter pressure limit, then provide an alarm which indicates the specific AHU filter is dirty.

D. Indicate current pressure drops and dirty limit on each AHU and FCU graphic page.

E. Provide a separate graphic page on the new, BAS which is dedicated to filters. Provide a table which indicates all filters for all AHUs, the current pressure drop and the dirty pressure drop, as well as a 'dirty filter' indication for all filters sections that exceed the dirty pressure drop. An example of the table is as follows.

Unit Name	***Location***	***Filter Type***	***Pressure Drop Actual***	***Dirty Limit***	***Dirty?***	***Filter Type and Size***	***Quantity***
AHU-1	Mech room 1	Pre	Actual Press Drop	0.6"	Yes/no	By mech contractor	By mech contractor
AHU-1	Mech room 1	Final	Actual press drop	1.5"	Yes/no	By mech contractor	By mech contractor
AHU-2	Mech room 2	Pre	Actual Press drop	0.6"	Yes/no	By mech contractor	By mech contractor

F. For each air handling unit graphical screen provide a button to access a separate graphical screen containing just reheat coils associated with that air handling unit.

3.15 AHU REHEAT COIL PROGRAMMING TABLE

A. Provide a reheat coil table similar to the following for each AHU/RTU with reheat coils:

Reheat Coil	***Serving Room***	***Sensor Set point***	***Space Temp***	***Temp Difference***	***Command Valve Position***	***Actual Valve Position***	***Supply Air Reset Calc***	***Coil Problem?***
1	Clean storage	Input from sensor	Input from sensor	Sensor set point – space temp	45%	46 %	ν Yes □ No	Yes/ no
2	Corridor	Input from sensor	Input from sensor	Sensor set point – space temp	21%	21 %	ν Yes ÍNo	Yes/ no
3	Office 23	Input from sensor	Input from sensor	Sensor set point – space temp	10%	10 %	□ Yes ν No	Yes/ no

B. Provide diagnostic logic in the "Coil Problem" column to identify a problem if a) temp difference is more than 2F for more than 10 minutes, b) or the actual valve position differs from the commanded position by 5% for more than 10 minute Provide diagnostic logic in the "Coil Problem" column to identify a problem if a) temp difference is more than 2F for more than 10 minutes, b) or the actual valve position differs from the commanded position by 5% for more than 10 minutes.

C. Pick boxes shall be in the “Supply Air Reset Calc” column to allow the user to include or exclude a particular reheat coil valve form the reset calculation.

END OF SECTION 230993

SECTION 23 0994 – CONTROL SEQUENCE - WATERSIDE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 specifications, apply to this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to Section 230900 – Instrumentation and Control for HVAC.

PART 3 - EXECUTION

3.1 GENERAL

A. This section is a supplement to the control diagrams on the drawings. The control diagrams generally indicate control devices as well as some desired logic. This section provides the basis for the sequences of operations, the control logic, device location clarification, measurements, as well as the general intent of the outcome for the control systems.

B. The Execution Section Paragraphs are arranged in an alternate way to improve the clarity of the intent by avoiding duplication and repetition of the requirements common to multiple systems.

C. The abbreviations AFD, ASD, and VFD are used interchangeably and all represent the same adjustable speed drive controller for a motor.

D. This section includes specific requirements for Waterside control sequences. General and Airside control sequence provisions are included in another Section.

3.2 GENERAL REQUIREMENTS FOR WATERSIDE SYSTEMS:

A. CONTROLLER POWER: The power for equipment control panels shall be powered from the line side of the starter for the equipment controlled or from a separate circuit (by Div. 23) so that the controller will continue to have power and will stay on the BAS network when the unit starter is turned off or is off due to failure.

B. EMERGENCY POWER: If the equipment being controlled is on emergency power, then the controller must also be on emergency power along with the associated devices. Spring return closed valves on coils and equipment and/or zones must be used to restrict limited emergency power mode water flow to only the equipment on emergency power. Consult with the engineer.

C. CONTROL DEVICE POWER: The basis for control and monitoring of all actuators and control devices is to use low voltage 24V power. The controls contractor shall provide low voltage wiring for all controls. Since different controls contractors would execute the control wiring in different ways, the project documents do not include locations for source 120V power to feed the 24V power wiring – that task shall be the responsibility of the successful controls contractor. The controls contractor shall coordinate with the electrical contractor and compensate the electrical contractor for desired quantities and locations for 120V power sources to feed their low voltage system design.

D. GRAPHIC DISPLAYS AT OPERATOR INTERFACE – WATERSIDE SPECIFIC: Create graphical display pages for the equipment and systems on the project, including but not limited to the following. Refer to other paragraphs for specific requirements for data points.

1. Pumps
2. Heat Exchangers
3. Boilers and Heaters
4. Domestic Hot Water System – monitoring only
    a.

E. General Graphic Point Displays for Equipment

1. Microprocessor Based Equipment Controllers

    a. In addition to the following points listed for general graphics screens, clicking on a piece of equipment with a microprocessor based controller (VFD, chiller, etc) shall bring up a separate screen listing operating values for that piece of equipment, as extracted through common industry protocols (BACnet, Lontalk, Modbus, etc).

2. Pumps:

    a. Pump start/stop command
    b. Cumulative pump start total
    c. Proof and Operating amp/kW – Bar Graph with marks
    d. Minimum, maximum pump amps (From TAB)
    e. Pump alarm – fault from VFD and/or proof failure from current sensor
    f. VFD drive status

3. Heat Exchanger:

    a. All temperatures in and out
    b. All commanded valve positions
    c. All actual valve positions
    d. Alarm if actual valve position differs from commanded position by >20%

4. Heating System & Boilers

    a. Loop pumps & VFD – refer to “Pumps”
    b. Master Boiler Control Panel – major status points, including outdoor air reset
    c. Individual Boilers – inlet & outlet temps, status, burner fire rate, associated pump & 3-way valve.

d. Main loop water temperatures and temperature setpoints including reset schedule setpoint.

5. Domestic Hot Water Heating System

a. Heater status
b. Pump status –recirculation pump, booster pump, etc
c. Supply water temperatures for each main loop

6. BTU Meters

a. Access to available current points – including but not limited to temperature, flow, pressure, etc.
b. Access to cumulative BTU/hr recorded data

3.3 PACKAGED EQUIPMENT CONTROLS INTERFACE

A. It is common for project equipment from manufacturers to have self-contained controls and microprocessor logic such as packaged pump systems, boilers, condensing units, etc. The self-contained equipment's controls should be 'connected' and integrated into the overall control system for the project. Internal data points related to operation should be pulled from the self-contained control system so that the operator can view operating data points. And key adjustable operating setpoints such as temperatures and pressures should be able to be input into the self-contained equipment's control system.

B. If equipment substitutions are made, then the equipment's self-contained control package should include the control logic and sequence capabilities described in the subsequent paragraphs. Not all features will be available from all manufacturers, which means the controls contractor may have to provide supplementary control logic on stand-alone controllers to meet the sequence of operations design intent.

3.4 WATER SIDE SYSTEM AND EQUIPMENT BASIC CONTROL REQUIREMENTS

A. General Requirements. The following basic features shall be included for water side equipment and systems. These basic items are not duplicated in subsequent sections.

1. START/STOP. Each piece of equipment shall be enabled / disabled by the BAS. Unit controls shall operate automatically when energized.
2. NORMALLY ON/OFF. The normally OFF (disabled) status shall be equipment off and isolation valves closed. The normally ON status shall be equipment on and isolation valves open.
3. VALVE ACTUATORS: Actuators shall be 24V and shall be the responsibility of the controls contractor.
4. OCCUPIED MODE: Provide an Occupied mode of operation for each unit or system. During the Occupied mode, the unit shall operate according to the listed sequences of operation.
5. UNOCCUPIED MODE: Provide an Unoccupied mode of operation for each unit or system. During the Unoccupied mode, the temperature setpoint range may be increased, and some equipment may be off.

6. DEADBAND MODE: In deadband mode between On and Off setpoints, the equipment may be off.
7. DP SENSOR TUBE TAPS: Taps for differential pressure sensors (and switches) in piping shall be on the SIDE of the pipe, not on the top. When the taps are on the top, air can accumulate in the tubing and in the sensor causing early failure.
8. ISOLATION VALVES. The actuated isolation valves for equipment are intended to be full line-size, however, they may be required to modulate.
9. PUMP AND COOLING TOWER FAN PROOF OF FLOW. Constant and 2-speed motors shall be provided with current sensors (not switches). An adjustable software variable for amp or kW shall be used for proof of flow. The initial proof variable setpoint shall be 50% of normal power level as measured by TAB. Variable speed motors with VFD's shall use a kW output value from the drive. The initial proof variable setpoint shall be slightly higher than the power level at the internal minimum speed setpoint.

3.5 CHILLED WATER SYSTEM TEMPERATURE REFERENCE

A. Refer to drawings for sequence:

Main Chilled Water Loop Supply Temp	44F
Main Chilled Water Loop expected Return Temp	64F
Main Chilled Water Loop Delta-T (return – supply)	20F

B. Refer to drawings for sequence

1. Building chilled water pumps shall be variable speed with VFDs.
2. All pump VFD's shall operate at the same speed (all parallel pumps should operate at the same speed). Pump speed signals shall be independently wired to the pump controller. Daisy-chaining from one VFD to another VFD is not permitted because turning off the first VFD will result in a loss of speed signal to the downstream drives.
3. For systems sized for a single pump handling normal flow, and a backup pump, the normal sequence for lead/lag failure and rotation shall be used. (also called Duty and Backup).
4. Upon indication of a loss of flow through the lead pump for a continuous duration of 15 seconds (adjustable), an alarm signal shall be received at the BAS. Upon continued loss of flow for an additional 30 seconds (adjustable) the BAS shall turn ON the Lag pumping unit. The initiation and proof of flow of the Lag pump shall initiate an orderly shutdown of the failed secondary pump.

3.6 DOMESTIC HOT WATER SYSTEM

A. Provide monitoring of the status of equipment including loop pumps, booster pumps, heaters, as well as the main supply loop temperatures. Provide a system loop graphic for the domestic hot water system.

B. Provide current sensors to monitor pumps if they were not provided by the plumbing installing contractor.

3.7 CHEMICAL TREATMENT SYSTEMS

A. Provide interlocking controls for the chemical treatment systems to coordinate operation of the systems. Basically, the chemical treatment system shall only be ON when the associated system is on.

B. Provide a condenser water system blowdown meter if it is not provided by the chemical treatment vendor.

C. Since chemical treatment systems are highly variable from various vendors, coordinate with the successful chemical treatment vendor for controls and interlocks required for proper system operation.

3.8 HEAT EXCHANGERS:

A. Refer to drawing for heat exchanger sequence:

3.9 BTU METERS

A. Provide a BTU/hr meter for individual buildings and separate tenant spaces for recording actual BTU usage for the purposes of individual billing. If the tenant space cannot be metered in one location then each piece of local equipment shall be metered. The equipment shall be appropriately labeled for used in legal tenant billing.

B. Provide a database suitable for collecting, analyzing, reporting, and billing on BTU usage.

3.10 STEAM

A. Control for steam systems is generally limited because few steam line devices are actively controlled by the building management system. Refer to the Hot Water System controls for the water side sequence of operations.

B. Packaged Boiler Controls.

1. Packaged boiler controls are expected to be provided by the manufacturer. Work with the boiler manufacturer's start-up representative to provide all customary and code required controls including, but not limited to:

    a. Low boiler water level alarms and shutdown
    b. High boiler water level alarms and shutdown

C. Condensate Return Pumps

1. Condensate return pumps shall be self-contained and operate by high and low level sensors in the tank. When the tank is full, pumps turn on to return condensate back to the boiler plant. When the tank is empty, the pumps turn off automatically.

END OF SECTION 23 0994

SECTION 23 2110 - HYDRONIC DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping for hydronic distribution systems for chilled water piping outside the building. Piping includes pipes, fittings, valves, insulation, and specialties for the following:

1. Manufactured, pre-insulated piping systems.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for concrete aggregate used in conduit systems for pipe supports.
2. Division 23 Section "Hydronic Piping and Valves" for hydronic piping systems inside the building.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing chilled water piping systems with the following minimum working-pressure ratings: (Note: Some Part 2 Products are specified with higher pressure rating requirements.)

1. Chilled-Water Piping: 150 psig**.**

1.3 DEFINITIONS

A. The following are industry abbreviations for plastic and rubber piping materials:

1. PVC: Polyvinyl chloride plastic.

B. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F or W/m x K at the temperature differences specified. Values are expressed as Btu or W.

1. Example: Apparent Thermal Conductivity (k-Value): 0.26 or 0.037.

1.4 SUBMITTALS

A. Product Data: Include carrier piping, insulation type and k-value, jacket, end seals, and major components for each cased piping system.

B. Shop Drawings:

1. Provide signed and sealed calculations by a qualified professional engineer for pre-manufactured pre-insulated piping systems.

2. Calculate requirements for expansion compensation for underground piping.

3. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
4. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.
5. Thrust block calculations and soil bearing strength values shall be subject to the approval of the civil or structural engineer of record.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from hydronic distribution piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic distribution piping.

E. Field Reports: Indicate and interpret test results for compliance with performance requirements.

1. Manufacturer's Installation Report: Manufacturer's field inspection report, approved and signed by authorized factory agent.

F. Warranties: Special warranties specified in this Section.

1.5 COORDINATION

A. Coordinate pipe-fitting pressure classes with products specified in related Sections to allow matching of flange bolt holes.

B. Coordinate underground utility routing with new and existing utilities.

C. Coordinate piping system thrust block design and installation.

1.6 QUALITY ASSURANCE

A. Preconstruction conference: Conduct conference at Project Site to comply with requirements of Division 01 Section "Project Management and Coordination."

B. Manufacturer's Approved Installation Methods: The entire installation shall conform to the requirements of the piping system manufacturer, including thrust block layout and design.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify University Representative no fewer than two weeks in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without the University's Representative written permission.

1.8 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the University of other rights the University may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pre-Insulated Underground Piping Systems:

a. Perma-Pipe, Inc. – Extu-Therm
b. Rovanco Corp.
c. Thermal Pipe Systems, Inc.
d. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 INSULATED PIPING SYSTEM

A. Service Pipe

1. Std. weight, ASTM A53 Gr. B ERW carbon steel.

B. Joints:

1. Butt welded for 2.5" and larger.
2. Butt or socket welded for 2" and smaller

C. Insulation:

1. General: Terms used in this Article are defined in ASTM C 168.
2. Insulation Type: Polyurethane – 90% closed cell piping insulation:

a. Thermal conductivity (K-valve): 0.16 at 75 deg F. mean temperature.
b. Density: 2-3-lb/cu. Ft. average.

c. Jacket: Seamless HDPE per ASTM D 1248, type 3, Class 3

4. End Seals: Seals shall be designed and factory fabricated to prevent the ingress of moisture into the system. Painted on end seals of any type shall not be allowed.
5. Pipe Joint Insulation System: Provide manufacturer's field-applied insulation and jacketing option on field joints. Piping joints shall be insulated to match factory-applied insulation R-value, and jacketed with heat-shrink type outer jacketing.

2.3 JOINING MATERIALS

A. Gasket Materials: ASME B16.21, nonmetallic, asbestos free, rubber, and suitable for system liquid.

B. Flange Bolts and Nuts: stainless steel.

C. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

D. Welding Filler Metals: Comply with AWS D10.12 for welding material appropriate for wall thickness of steel pipe to be welded.

2.4 VALVES

A. Refer to specification 23 2113, Hydronic Piping and Valves

B. Valve Boxes**:** Cast iron valve boxes for shut off valves buried in ground shall be complete with bell bottoms, extension piece, top and cover. Boxes shall be suitable for the types of valves with which they are used. Lids shall have the letters CHWS or CHWR embossed on the top surface.

2.5 CORROSION-PROTECTION ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008inch minimum thickness, tube or sheet.

PART 3 - EXECUTION

3.1 TRENCHING AND BACKFILLING

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, bedding, and backfilling for underground piping.

3.2 FITTING AND JOINT CONSTRUCTION

A. Fitting, Joints: Prepare piping and fittings and join according to manufacturer's written instructions.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

B. Install piping free of sags and bends.

C. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

D. Install fittings for changes in direction and branch connections.

E. Fittings shall have ends sealed with tape prior to pouring concrete thrust blocks.

F. Provide manufacturer’s optional end seals, field-installed insulation at joints and fittings, and field-installed heat-shrink wrap type jacketing. Outer jacketing shall be water-tight.

G. Remove any standing water in the bottom of trench.Bedding depth and spacing between piping shall be in accordance with manufacturers installation insturctions.

H. Do not insulate piping or backfill piping trench until field quality-control testing has been completed and results approved.

I. Install drains at low points inside the building consisting of tee fitting, 3/4-inch NPS ball valve, and short 3/4-inch NPS threaded nipple and cap.

J. Make reductions in pipe sizes using eccentric reducer fitting installed with level side up.

K. Install flanges according to manufacturer's written instructions.

L. Refer to Division 23 Section "Common Work Results for HVAC" for sleeves and mechanical sleeve seals through exterior building, trench, and tunnel walls.

M. Piping Connections: Make piping connections to existing steel distribution piping and building steel piping system with flanges.

N. Provide engineered thrust blocks and ancu0rs on buried piping where determined by manufacturers Engineer and shown on manufacturers shop drawings.

1. Thrust blocks shall be concrete having a compressive strength of not less than 2000 psi after 28 days and shall be in accordance with Division 03, Section “Cast-In-Place Concrete.”
2. Thrust blocks shall be placed between solid ground and the fitting to be anchored. The base and the thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth.
3. The sides of the thrust blocks not subject to thrust may be poured against forms.
4. Thrust blocks shall be placed so that the joints for all fittings will be accessible for repair in the future. No pipe joint shall be embedded in concrete.
5. The thrust blocks shall provide for transfer of thrusts and reactions without exceeding the allowable stress of the concrete and shall be installed in accordance with pipe manufacturer's instructions.

O. Pipe expansion shall be installed per pip manufacturer's written instructions.

1. Provide underground alignment guide and secure with concrete thrust blocks if recommended by manufacturer’s written instructions.

3.4 IDENTIFICATION INSTALLATION

A. Install continuous plastic underground warning tapes and detectable wire for non-metallic piping during back-filling of trenches for underground hydronic distribution piping. Refer to Division 31 Section "Earth Moving" for warning-tape and detectable wire materials and devices and their location and installation.

3.5 FIELD QUALITY CONTROL

A. Provide manufacturer’s field construction supervision and installation inspection services with complete written report. Obtain manufacturer’s written installation approval prior to trench backfilling.

B. Prepare hydronic piping for testing according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Isolate equipment. Do not subject equipment to test pressure.

3. Fill system. Use ambient temperature water.
4. Install relief valve set at pressure no more than one-third higher than test pressure.
5. Use vents installed at high points to release trapped air while filling system.

C. Test hydronic piping as follows:

1. Subject piping system to hydrostatic test pressure at 150 PSI or 1.5 times the design pressure, whichever is greater, for four hours. There shall be no decrease in pressure allowed over the four hour test.
2. After hydrostatic test pressure has been applied, examine piping, joints, and connections for leakage throughout the testing period. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
3. Prepare a written report of testing.

b Hydronic piping may be pre-tested with air at 100 psi. After successful testing, pipe may be buried and hydrostatically tested at a later date.

3.6 CLEANING

A. Inspect finish of exposed, hydronic piping, including outlets, valves, specialties, and devices, after installation is complete. Remove burrs, dirt, and debris. Repair damaged finishes including chips, scratches, and abrasions.

B. Clean and flush hydronic piping. Remove, clean, and replace strainer screens. Remove disposable fine-mesh strainers in pump suction diffusers after cleaning and flushing piping but before balancing.

END OF SECTION 23 2110

SECTION 23 2113 - HYDRONIC PIPING AND VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping, special-duty valves, and hydronic specialties for hot-water heating, chilled-water cooling, process cooling loops, and condenser water systems; makeup water for these systems; blowdown drain lines; and condensate drain piping.

B. Related Sections include the following:

1. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
3. Division 23 Section "Common Work Results for HVAC" for general piping materials and installation requirements.
4. Division 23 Section "Hangers and Supports for HVAC" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
5. Division 23 Section "Mechanical Vibration and Seismic Controls for HVAC" for flexible pipe support and anchorage product descriptions, and installation requirements.
6. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for flexible pipe accessory product descriptions, and installation requirements.
7. Division 23 Section "Meters and Gages for HVAC" for thermometers, flow meters, and pressure gages.
8. Division 23 Section "Identification for HVAC" for labeling and identifying hydronic piping.
9. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
10. Division 23 Section “HVAC Water Treatment” for chemicals, feeders and water treatment requirements.
11. Division 23 Section "Instrumentation and Controls" for temperature-control valves and sensors.

1.2 SUBMITTALS

A. Product Data: For each type of valve indicated. Include flow and pressure drop curves based on manufacturer's testing for valves, diverting fittings, manual calibrated balancing valves, and automatic flow-control valves.

B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

E. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 01.

F. Piping, fittings, and accessories: For each type of materials indicated, including gaskets.

1.3 QUALITY ASSURANCE

A. Delete paragraph below if no welding. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.4 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Penetration Firestopping" for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grooved Mechanical-Joint Fittings and Couplings:

a. Anvil International, Inc.
b. Victaulic Company of America.
c. Or equal.

2. Manual Calibrated Balancing Valves:

a. Armstrong
b. Griswold Controls.
c. Tour and Andersson
d. Victaulic Company of America
e. Or equal.

3. Pressure-Reducing Valves:

a. Conbraco Industries, Inc.
b. Hersey
c. Febco
d. Watts Industries, Inc.; Watts Regulators.
e. Or equal.

4. Safety Valves:

a. Conbraco Industries, Inc.
b. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
c. Kunkle Valve Division.
d. Spence Engineering Company, Inc.
e. Or equal.

5. Automatic Flow-Control Valves:

    a. Griswold Controls.
    b. Or equal (No known equal).

6. Expansion Tanks:

    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett
    d. Taco, Inc.
    e. Wheatley
    f. Or equal.

7. Air Separators and Air Purgers:

    a. Bell and Gossett
    b. Spiro Research Company; Spirotherm, Inc.
    c. Or equal

8. Piping and fittings:

    a. Pipe and fittings shall be of domestic, or foreign.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32, Alloy E.

E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

F. Press Fittings

G. T-Drill

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe, NPS ¾ through NPS 1½: ASTM A 53, Type S (seamless) Grade A or B, Schedule 40, black steel, plain ends.

B. Steel Pipe, NPS 2 through NPS 10: ASTM A 53, Type S (seamless) or Type ERW (welded) Grade A or B, Schedule 40, black steel, plain ends.

C. Steel Pipe, NPS 12 and larger: ASTM A 53, Type S or Type ERW (welded) Grade B, 0.375 inch wall thickness, black steel, plain ends.

D. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless.

E. Malleable-Iron or Steel Threaded Fittings: ASME B16.3, Classes 150 and 300 or steel.

1. Fabricated per ASME

F. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

G. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.

H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised or flat face.

I. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.

J. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

K. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

L. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

M. Flexible Connectors and Expansion Joints: See Division 23, Section "Expansion Fittings and Loops for HVAC Piping".

2.5 VALVES

A. Ball Valves: (Sizes NPS ½"– 2", typical)

1. Two-Piece, copper-alloy, MSS SP-110, Bronze body with full-port, 316 stainless steel ball and stem PTFE seats; and 600-psig minimum CWP rating and blowout-proof stem. Stem length shall clear insulation.

    a. Conbraco Industries, Inc.; Apollo Div. Model #77-140 (threaded) or Model #77-240 (soldered)
    b. Milwaukee.
    c. NIBCO Inc.
    d. Or equal.

B. AWWA, Cast-Iron Gate Valves for non-hot water applications:

1. Manufacturers:

    a. American Cast Iron Pipe Co.; American Flow Control Div.
    b. Crane Co.; Crane Valve Group; Stockham Div.
    c. Grinnell Corporation; Mueller Co.; Water Products Div.
    d. Mueller
    e. NIBCO INC.
    f. United States Pipe and Foundry Company.
    g. Milwaukee.
    h. RP&C.
    i. Bonney Forge.
    j. Or equal.

2. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

    a. Minimum Working Pressure: 200 psig.
    b. End Connections: Mechanical joint, or flanged.
    c. Interior and Exterior Coating: Complying with AWWA C550, epoxy.

C. Cast-Iron Gate Valves for hot water applications:

1. Manufacturers:

    a. Type I, Cast-Iron, Rising-Stem Gate Valves:

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Crane Co.; Crane Valve Group; Jenkins Valves.
3) Crane Co.; Crane Valve Group; Stockham Div.
4) Milwaukee Valve Company.
5) NIBCO INC.
6) Powell, Wm. Co.
7) Walworth Co.
8) Watts Industries, Inc.; Water Products Div.
9) Or equal.

2. Cast-Iron Gate Valves, General: MSS SP-70, Type I.

a. Class 125, OS&Y, Cast-Iron Gate Valves: Cast-iron body with bronze trim, renewable bronze seat rings, rising stem, and tapered solid-wedge disc.

D. Check Valves:

1. Sizes NPS ¾"– 2": Horizontal Swing Bronze Check Valve, Class 125, MSS-SP-80, two-piece bronze body and seat, full port, blowout proof, threaded ends.

a. Crane Co.; Crane Valve Group; Crane Valves
b. Crane Co.; Crane Valve Group; Stockham Div.
c. NIBCO INC.
d. Spriax Sarco
e. Or equal.

2. Sizes NPS 2½"- larger: Swing Check, Type 1, Class 125, MSS-SP-71, cast-iron body, flanged with bronze seat and bronze trim, bolted cap.

a. Crane Co.; Crane Valve Group; Crane Valves. 373.
b. Crane Co.; Crane Valve Group; Stockham Div. G931.
c. NIBCO INC. F-918-B.
d. Or equal.
e. Spirax Sarco.
f. Mueller.

3. Sizes NPS ¾" – 2": Non-slam Check, Class 125, bronze body and seat, tight shut-off, threaded ends. Rated for 200 °F applications.

a. Conbraco Industries, Inc.; Apollo Div. 62-100.

b. Crane Co.; Crane Valve Group; Stockham Div.
c. NIBCO INC. T-480.
d. Spirax Sarco.
e. Mueller.
f. Or equal.

4. Sizes NPS 2½"-larger: Non-slam Check, Type 1, Class 125, MSS-SP-71, cast-iron body, flanged with bronze seat and bronze trim, bolted cap.

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Div.
c. NIBCO INC. F-910.
d. Spirax Sarco.
e. Mueller.
f. Or equal.

E. Iron Butterfly Valves:

1. Sizes 2 ½" and larger: 150 psig CWP rating, cast/ductile iron construction, tight shutoff, lug pattern EPDM liner, lever operator, Aluminum ,bronze or ductile iron disc, epoxy coated body.

a. DeZurik.
b. Henry J. Pratt Company
c. NIBCO INC.
d. Milwaukee ML 224-E-A
e. Or equal.

F. Manual Calibrated Balancing Valves, NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain manually set position.

G. Manual Calibrated Balancing Valves, NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain manually set position.

H. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

I. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

J. Automatic Flow- Limiting Device: factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with test probes. Each valve shall have an identification tag outside of insulation attached by chain, and be factory marked with the zone identification, valve number, and flow rate. The body shall bear factory standard product tag. Valve shall be line size and one of the following designs depending on the system:

1. Gray-iron or brass body, designed for 175 psig at 200 deg F with stainless-steel cartridge/piston and spring.
2. Brass body, designed for 175 psig at 200 deg F with stainless-steel cartridge/piston and spring.

K. Pressure Sustaining and Pressure Regulating Valve: The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

1. Valve body shall be of cast Ductile Iron material and have stainless steel trim.
2. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert.
3. The diaphragm assembly containing a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off.
4. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve with stainless steel trim designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a fixed orifice. The pilot system shall include an opening speed control on all valves 3” and smaller on the model 92-01 and 4” and smaller on the model 692-01, as standard equipment. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge.
5. The pressure sustaining pilot control shall be a direct-acting adjustable spring loaded control which opens when upstream pressure exceeds the spring setting on the pilot. The pilot control system shall include an X44A strainer & orifice assembly.

6. A full range of spring settings shall be available in ranges of 0 to 450 psi. Downstream spring range shall be 2-30 psi.
7. A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.
8. The valve shall be a Cla-Val Co. Model No. 750-01 Combination Pressure Reducing & Sustaining Valve as manufactured by Cla-Val Co., Newport Beach, CA 92659-0325 or equal.

L. Refer to Part 3 "Valve Applications" Article for applications of each valve.

M. Combination duty type valves and fittings shall not be used.

N. Combination Assemblies: Individual threaded components, ball valves, control valve, automatic flow limiting device of brass body construction, fitted with pressure and temperature test valves, strainer, and designed for 300 psig at 250 deg F for duct or terminal mounted heating coils. See Campus Standard detail.

2.6 HYDRONIC SPECIALTIES

A. Manual Air Vent Bronze body ball valve with stainless steel ball; NPS ½.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS ½" or ¾" inlet connection. Provide only one automatic air vent in system at air separator.

C. Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 250 deg F maximum operating temperature with rustproof coating. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, shipped with minimum of 12 psig charge.

D. Air Separators: Welded black steel; ASME constructed and labeled for 150 psig minimum working pressure and 270 deg F maximum operating temperature; tangential Viton seal and Oring brass vent head and skim valve, copper coalescing medium, non-ferrous float, in-line inlet and outlet connections; threaded connections for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger; threaded blowdown connection. Provide units in sizes for full-system flow capacity with pressure loss performance of less than one foot of water, and maximum velocity of 4 feet per second, as manufactured by Spirotherm, or equal as manufactured by

others with greater than line size inlet as required to meet performance requirement of less than one foot of water at design flow capacity. E. Y-Pattern Strainers NPS 2 and smaller:

1. Strainers 2" and smaller for heating and air conditioning water service shall be based on Watts No. 777 or an equivalent strainer by Armstrong or equal, 400 psig WOG bronze body, threaded, Y-pattern, 20-mesh stainless steel screen, with a full size drain connection and ball valve.

F. Y-Pattern Strainers NPS 2-1/2 and larger:

1. Strainers 2-1/2" and larger for heating and air conditioning water service shall be based on Watts No. 77F-DI, Keckely Style "A", or an equivalent strainer by Armstrong or equal, Class 125 cast-iron body, flanged, Y-pattern, stainless steel screen, with a drain connection and ball valve (as described elsewhere herein).

G. Suction Diffuser: Angle or straight pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot Water Heating and Chilled Water (above ground):

1. NPS 2 and smaller: Type L copper; with 95-5 soldered wrought copper fittings.
2. NPS 2-1/2 and larger: Black steel pipe, ASTM A53, Type S (seamless) or Type ERW (welded); with standard weight ASTM A234 forged steel fittings for butt-weld connection or 150 lb; or grooved mechanical joint coupling and fittings with roll grooved mechanical joints.

B. Heating and Chilled Water Pot Feeder:

1. Type L Copper: Type L copper: with Alloy E soldered, BCup-5 AWS A5.8/A5.8M per ASME and wrought copper fittings.

C. Equipment Connections

1. NPS 2 and smaller: Use union connections.
2. NPS 2-1/2 and larger: Use flange connections.
3. Dissimilar metals: Where piping is connected to equipment with different materials, such as ferrous to copper, use brass union, brass coupler, brass pipe/nipple in order to prevent

electrolysis.

4. Valves: Provide shut-off duty isolation valves at all equipment.

D. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications for hydronic systems unless otherwise noted, use the following valve types:

Type	**Minimum Size**	**Maximum Size**	**Valve Service:**
Ball	¾"	2 "	Shut-off, and Throttling duty.
Gate, AWWA (chilled water)	2½"	12"	Shut-off duty.
Butterfly (chilled water)	2 ½"	n/a	Shut-off duty.
Gate, rising stem (HHW water)	2½"	n/a	Shut-off duty.
Butterfly (HHW water)	2 ½"	n/a	Shut-off duty.
Ball - Check (HHW)	¾"	2"	Check valve.

B. Install main building shut-off valves for hydronic systems.

C. Install shutoff duty valves at each riser branch connection to supply and return mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line.

D. Install auto flow limiting balancing valves in the return water line of each heating or cooling element. Install manual calibrated balancing valve at split coils as shown on the University's standard coil piping diagram.

E. Reheat Coils: Provide combination assemblies as described in Part 2, with flow limiting device and where equipment has rotating motors.

F. Hydronic systems which utilize flow limiting devices as balancing means shall include flow limiting devices on all system user branch take-off's at heat exchange device for system uniformity and proper system balance and operation.

G. Combination duty type valves and fittings shall not be used.

H. See Division 23 Section "Instrumentation and Controls" for hydronic control valve requirements.

I. Install check valves at each pump discharge and elsewhere as required to control flow direction.

J. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

K. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

L. All water valves operating between 32 and 95°F and larger than 2" shall be CHW butterfly valves. Where the valves are insulated to prevent sweating (e.g. chilled water) the valves shall be non- rising stem. Other applications may be either rising stem or non-rising stem as required. Except where buried outside, the valves shall have handwheels. Buried valves shall have 2" square operating nut.

3.3 PIPING INSTALLATIONS

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping installation requirements.

B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

D. Install piping level or at a uniform grade of 0.2 percent in direction of flow or a drain.

E. Where possible, reduce pipe sizes using eccentric reducer fitting installed with level side up- top flat.

F. Install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom or top of the main pipe or using fabricated saddles per ASME B31.9 criteria. For up-feed risers, install the takeoff coming out the top of the main pipe where possible.

G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

H. Anchor piping for proper direction of expansion and contraction.

I. Do not use groove-joint fittings on insulated piping system, unless insulation system is specifically designed for groove-joint fittings. J. Avoid underground piping.

K. Piping penetrations shall be carefully detailed. Insulation through penetrations shall be continuous.

L. Bushings and short nipples shall be used only where necessary.

M. Avoid pipe joints located over, or within 2 feet of electrical equipment. If it cannot be avoided provide with drip pans.

N. Teflon tape shall be utilized for threaded pipe joints.

O. Provide pipe and fittings of similar materials so dielectric fittings are not needed; i.e. only brass and bronze fittings with copper piping.

P. Grooved Mechanical-Joint Fittings and Couplings:

1. Piping shall be roll grooved only. Cut groove piping is not allowed.
2. Gaskets shall be EPDM.
3. Install per manufacturer's installation instructions.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC." Comply with requirements below for maximum spacing of supports. B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze When necessary..
4. Spring hangers to support vertical runs.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

NPS	Maximum span (feet)	Minimum rod size (inches)
3/4	7’	¼”
1	7 ‘	¼”
1-1/2	9’	3/8”
2	10’	3/8”
2-1/2	11’	3/8”
3	12’	3/8”
4	14’	½”
6	17’	½”
8	19’	5/8”
10	20’	¾”
12	23’	7/8”
14	25’	1”
16	27’	1”
18	28’	1-1/4”
20	30’	1-1/4”
24	32’	1-1/4”

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes. Comply with hanger manufacture spacing requirements.

NPS	Maximum span (feet)	Minimum rod (inches)
3/4	5 ‘	1/4 “
1	6 ‘	1/4 “
1-1/2	8 ‘	3/8 “
2	8 ‘	3/8 “
2-1/2	9 ‘	3/8 “
3	10 ‘	3/8 “

E. Support vertical runs at roof and at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for joint construction

requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install one automatic air vent per system in mechanical equipment rooms only at air separator for system air venting.

C. Install in-line air separators in pump suction lines. Install drain valve on units NPS 2 and larger.

D. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

E. Provide pot-feeder in heating systems and only in non-central plant chilled water systems.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections.

B. Install shut-off valves, strainers, accessories.

C. Install control valves in accessible locations close to connected equipment.

D. Never install bypass piping around control valves.

E. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with city water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test at 150 PSI or 1.5 times the design pressure, whichever is greater, for four hours. There shall be no decrease in pressure over the four hour test period. Isolate equipment subject to damage from test pressure. Make no test against a service valve or meter. Isolate from the system all existing piping and new or existing equipment that may be damaged by test pressure. Test only new piping unless instructed otherwise. Final connection between new and existing piping shall be tested at normal system operating pressures and monitored for leaks for three working days. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied, examine piping, joints, and connections for leakage throughout the testing period. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

c Hydronic piping outside the building may be pre-tested with air at 100 psi. Upon successful testing, pipe may be buried and tested at a later date.

3.9 ADJUSTING

A. Perform these adjustments before operating the system:

1. Open valves to fully open position.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vent at air separator and determine if it is operating freely (automatic type).
5. Check air vents at high points of system and bleed air completely (manual type).
6. Set temperature controls so all coils are calling for full flow.
7. Check and set operating temperatures of heating and chilled water systems to design requirements.
8. Lubricate motors and bearings.

3.10 CLEANING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 23 2113

SECTION 23 2123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following categories of hydronic pumps for hydronic systems:

1. In-line circulators.
2. Vertical in-line pumps.
3. End-suction pumps.

B. Related Sections include the following:

1. Division 23 Section "Variable Frequency Drives" for variable frequency drive requirements.
2. Division 23 Section "Motors for HVAC" for general motor requirements.
3. Division 23 Section "Mechanical Vibration and Seismic Controls for HVAC" for inertia pads, isolation pads, spring supports, and spring hangers.

1.2 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities including pump efficiency, BHP, RPM, Head, GPM; shipping, installed, and operating weights; furnished specialties; final impeller dimensions; motor specifications; and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For pumps to include in maintenance manuals specified in Division 01.

D. Provide pump alignment report that documents, as a minimum, the initial and final shaft orientations, and the changes made.

1.3 QUALITY ASSURANCE

A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.

B. Product Options: Provide pumps based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 01 regarding substitutions.

C. Regulatory Requirements: Fabricate “Pumps for Nomenclature, Definitions, Application and Operation," and HI 1.6, "Centrifugal Pump Tests."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University's Representative.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One entirely complete mechanical seal kit for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

1. In-Line Circulators:

a. Armstrong Pumps Inc.
b. Aurora Pumps.
c. Bell & Gossett
d. Grundfos Pumps Corp.
e. Paco Pumps.

2. Vertical In-Line Pumps:

a. Armstrong Pumps Inc.

b. Aurora Pumps.
c. Paco Pumps.

4. Flexible-Coupled, End-Suction Pumps:

a. Armstrong Pumps Inc.
b. Aurora Pumps
c. Bell & Gossett
d. Grundfos Pumps Corp.
e. Paco Pumps
f. Peerless Pump Co.
g. Weinman Pumps

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Refer to Section “Motors for HVAC” in Division 23. Select each motor to be non-overloading over full range of pump performance curve.

2.3 IN-LINE CIRCULATORS

A. Description: Horizontal, in-line, centrifugal, single-stage, bronze-fitted, radially split case design; rated for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.

1. Casing: Cast iron, with threaded companion flanges for piping connections, and threaded gage tappings at inlet and outlet connections.
2. Impeller: PES composite (30% glass-filled), single suction, and keyed to shaft.
3. Shaft and Sleeve: Aluminum shaft with stainless-steel sleeve.
4. Seals: Mechanical type. Include carbon-steel rotating ring, stainless-steel spring, ceramic seat, and EPDM Elastomers.
5. Pump Bearings: Aluminum oxide ceramics.
6. Motor Bearings: Oil-lubricated, sleeve type.
7. Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
8. Motor: Resiliently mounted to pump casing.

2.4 VERTICAL IN-LINE PUMPS

A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.

B. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze, fully enclosed type; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw.
3. Pump Shaft: Stainless steel.

C. Mechanical Seal: Stainless steel multi-spring outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide 316 stainless steel gland plate. Provide factory installed flush line with manual vent. Provide with a lower seal chamber throttle bushing to ensure seals maintain positively cooling and lubrication.

D. Coupling: Axially split spacer coupling. Rigid spacer type of high tensile aluminum alloy. Coupling to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor.

E. Motor: Rigidly mounted to pump casing with lifting eye and supporting lugs in top of motor enclosure.

2.6 FLEXIBLE-COUPLED, END-SUCTION PUMPS

A. Description: Base-mounted, centrifugal, flexible-coupled, end-suction, single-stage, bronze fitted, back-pull-out, radially split case design; rated for 175-psi minimum working pressure and a continuous water temperature of 250 deg F max.

1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
3. Wear Rings: Replaceable, bronze casing ring.
4. Shaft and Sleeve: Steel shaft with bronze sleeve.
5. Seals: Mechanical, with Hi resist seat, carbon washer, viton elastomer, stainless steel spring and parts.
6. Pump shaft bearings: Grease-lubricated ball bearings in cast-iron housing.
7. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
8. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
9. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.
10. Motor: Secured to mounting frame, with adjustable alignment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.

1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Install pumps according to manufacturer's written instructions.

1. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps, and loads are not transferred to pump flanges. Adjust pipe hangers so that flange gaskets require only slight moderate force to overcome frictional resistance when slip into place.

D. Install pumps according to manufacturer’s instructions.

E. Suspend in-line pumps using continuous-thread hanger rod and vibration-isolation hangers. Install seismic bracing as required by CBC.

F. Verify installation requirements with acoustic consultant and requirements. Provide base, pad, isolators, flexible connectors, inertia bases, and other sound treatment devices according to acoustic consultant’s recommendations.

G. Set base-mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

A. A millwright or manufacturer's representative startup technician shall align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

1. Alignment shall be reverse dial indicator or laser method.
2. Indicated run-out shall not exceed 0.001 inches.
3. Angular and offset misalignment shall be as follows:

	Maximum Angularity	Maximum Offset
1200 rpm	0.0015"	0.003"
1800 rpm	0.0010"	0.002"
3600 rpm	0.0005"	0.001"

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Shop drawings show specific locations.

B. Install piping adjacent to machine to allow service and maintenance and shall is no case cause a tripping hazard.

C. Connect piping to pumps. Install valves that are the same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install isolation valves on suction and discharge sides of pump.

F. Strainers: Install pipe strainer, or suction diffuser with strainer on floor-mounted pumps. Exception: Basket strainer shall be used on the suction of condenser water pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Check Valves: Install non-slam check valves on pump discharge line. Exception: Omit check valve when pump serves a single story building and it is a single pump mounted on the lowest floor.

I. Install inertia base and vibration isolation when not installed on slab on grade.

J. Install temperature and pressure gages on pump suction and discharge. Install at integral pressure-gage tappings where provided.

K. Install electrical connections for power, controls, and devices.

L. Electrical power and control wiring and connections are specified in Division 26 Sections. Rotate junction box on pump motor to provide the most direct power wiring connection from the source.

M. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.5 COMMISSIONING

A. Verify that pumps are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.

C. Perform the following preventive maintenance operations and checks before starting:

1. Lubricate bearings.
2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
5. Check suction piping connections for tightness to avoid drawing air into pumps.
6. Clean strainers.
7. Verify that pump controls are correct for required application.

D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:

1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
2. Open discharge valves, pumps should not be operated against dead shutoff.
3. Start motors.
4. Open discharge valves slowly.
5. Check general mechanical operation of pumps and motors.

E. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for detailed requirements for testing, adjusting, and balancing hydronic systems and Division 23 Section “Commissioning of HVAC”.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:

1. Train University's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
2. Review data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data."
3. Schedule training with University's Representative.

END OF SECTION 23 2123

SECTION 23 2213 - STEAM AND CONDENSATE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for LP and HP steam and condensate piping:

1. Pipe and fittings.
2. Strainers.
3. Flash tanks.
4. Safety valves.
5. Pressure-reducing valves.
6. Steam traps.
7. Thermostatic air vents
8. Vacuum breakers.
9. Steam and condensate meters.
10. Exhaust vent heads.
11. Muffling orifice plates.
12. Noise suppressors.

1.3 DEFINITIONS

A. HP Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.

B. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. HP Steam Piping 16 to 80 psig: 125 psig
2. LP Steam Piping: 100 psig.
3. Low Pressure Condensate Piping: 100 psig at 340 deg F.
4. High Pressure Condensate Piping (16 PSIG – 100 PSIG): 150 psig at 365 deg F
5. Pumped Condensate: 100 psig at 225 deg F.
6. Cold Water Make-up Piping: 80 psig at 150 deg F.
7. Boiler Feedwater Piping: Equal to 150 percent of the piping system pressure to which it is attached.

8. Boiler Blowdown Piping: Equal to pressure of the piping system to which it is attached.
9. Drain Piping: Equal to pressure of the piping system to which it is attached.
10. Boiler Trim Piping: Equal to pressure of the piping system to which it is attached.
11. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
12. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe and fittings.
2. Strainers.
3. Flash tanks.
4. Safety valves.
5. Pressure-reducing valves.
6. Steam traps.
7. Thermostatic air vents
8. Vacuum breakers.
9. Steam and condensate meters.
10. Exhaust vent heads.
11. Steam filter – Element type.
12. Steam separators.
13. Muffling orifice plates.
14. Noise suppressors.

B. Shop Drawings: Detail, [1/4 inch equals 1 foot] scale, flash tank assemblies and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.

C. Qualification Data: For Installer.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify processes and operators according to the following:

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.

B. Steel Pipe: ASTM A 106, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.

C. Malleable Iron Threaded Fittings: ASME B16.4; Classes 150 add 300 as indicated in Part 3 piping applications articles.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.

E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.

F. Wrought Carbon Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Carbon Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.2 BELOW GRADE STEAM PIPING AND CONDENSATE RETURN PIPING

A. Manufacturers

1. Perma-Pipe “Multi-Therm 500” or Ultratherm
2. Thermacor “Duo-Therm 505”
3. Rovanco “Hi-Temp Rhinocoat Conduit or Hi-Temp System”

4.

B. Description: All underground heat distribution lines shall be fiber glass jacketed steel conduit or 20 mil fusion epoxy coated steel jacketed conduit..

1. All straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions, and designed to minimize the number of field welds.
2. Each system layout shall be computer analyzed by the piping system manufacturer to determine stresses and movements of the service pipe. These calculations shall account for the interaction and movement of the existing pipe to create one piping system, fully integrated.
3. The system design shall be in strict conformance with ANSI B31.1 latest edition, and stamped by a registered professional engineer. Factory trained field technical assistance shall be provided for the critical periods of the installation; i.e., unloading, field joint instruction and testing.

C. Service Pipe:

1. Steam pipe shall be Standard weight carbon steel pipe, ASTM A106 Grade B, seamless or EWR.
2. Condensate piping shall be schedule 80 carbon steel, ASTM A106 Grade B or ASTM A53 Grade B.
3. Butt welded joints 2.5 inches and larger
4. Socket welded for 2 inches and below.
5. Where possible, straight sections shall be supplied in 40 foot random length with 6 inches of piping exposed at each end for field joint fabrication.

D. Subassemblies:

1. End seals, gland seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the system.
2. All subassemblies shall be designed to allow for complete draining and drying of the conduit system.

E. Service Pipe Insulation:

1. Insulation shall be FOAMGLAS cellular glass insulation, as manufactured by Pittsburgh Corning Corporation, in accordance with ASTM C-552 Standard Specification for Cellular Glass Thermal Insulation. The FOAMGLAS insulation shall be fabricated in half, curved sidewall, V-Groove or StrataFab insulation sections mineral wool, and calcium silicate insulation as an option.
2. The bore coating shall be Hydrocal B-11 gypsum cement, manufactured by U.S. Gypsum Corporation.
3. The insulation shall be secured to the pipe by stainless steel bands. Insulation thickness shall be as shown on the drawings.

F. Outer Conduit:

1. The steel conduit casing shall be smooth wall, welded steel conduit of the thickness specified below:

Conduit Size	Conduit Thickness
6" - 26"	10 Gauge
28" - 36"	6 Gauge
38" - 42"	4 Gauge

G. Pipe Supports:

1. All pipes within the outer casing shall be supported at not more than 10 foot intervals. These supports shall be designed to allow for continuous airflow and drainage of the conduit in place. The straight supports shall be designed to occupy not more than 10% of the annular air space. Supports shall be of the type where insulation thermally isolates the carrier pipe from the outer conduit.
2. The surface of the insulation shall be protected at the support by a sleeve not less than 12 inches long, fitted with traverse and, where required, rotational arresters.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 125, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.4 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Gate Valves, Flanged/Threaded:
1. Outdoor
   a. Low Pressure, High Temp/Low Temp
   b. High Pressure, High Temp/Low Tem
2. Indoor
   a. Low Pressure, High Temp/Low Temp
   b. High Pressure, High Temp/Low Temp

3. Manufacturers:

   a. Milwaukee.

   b. RP&C.

   c. Bonney Forge.

   d. NIBCO Inc.

C. Stop-Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.
   b. Jenkins Valves; a Crane Company.
   c. Lunkenheimer Valves.
   d. A.Y. McDonald Mfg. Co.

2. Body and Bonnet: Malleable iron.
3. End Connections: Flanged.
4. Disc: Cylindrical with removable liner and machined seat.
5. Stem: Brass alloy.
6. Operator: Outside screw and yoke with cast-iron handwheel.
7. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
8. Pressure Class: 125.

2.5 STRAINERS FOR LOW PRESSURE STEAM SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong International
2. Hoffman Specialty
3. Mueller Steam Specialties
4. O.C. Keckley Co.
5. Spirax Sarco

B. Y-Pattern Strainers:

1. NPS 2 and Smaller:

   a. Body: ASTM A 126, Class B cast iron with bolted cover and bottom drain connection.
   b. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
   c. Strainer Screen: Stainless-steel, per manufacturer’s recommended chart, and perforated stainless-steel basket with 50 percent free area.

d. Tapped blowoff plug.
e. CWP Rating: 125-psig working steam pressure.

2. NPS 2-1/2 and Larger:

a. Body: ASTM A 126, Class B cast iron or ASTM A216 Grade WCB Carbon Steel with bolted cover and bottom drain connection.
b. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
c. Strainer Screen: Stainless-steel, per manufacturer's recommended sizes or perforated stainless-steel basket with 50 percent free area.
d. Tapped blowoff plug.
e. CWP Rating: 125-psig working steam pressure.

2.6 STRAINERS FOR HIGH PRESSURE STEAM SYSTEMS (16 PSIG – 80 PSIG)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong International
2. Hoffman Specialty
3. Mueller Steam Specialties
4. O.C. Keckley Co.
5. Spirax Sarco

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron or ASTM A216 Grade WCB Carbon Steel, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, per manufacturer's recommended sizes or perforated, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. CWP Rating: 125-psig working steam pressure.

2.7 FLASH TANKS

A. Shop or factory fabricated of welded steel according to ASME Boiler and Pressure Vessel Code, for 150-psig rating; and bearing ASME label. Fabricate with tappings for low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs.

2.8 SAFETY VALVES

A. Bronze or Brass Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Kunkle Valve; a Tyco International Ltd. Company.
c. Spirax Sarco, Inc.
d. Watts Water Technologies, Inc.

2. Disc Material: Forged copper alloy.
3. End Connections: Threaded inlet and outlet.
4. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded or flanged inlet and outlet connections.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Cast-Iron Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Kunkle Valve; a Tyco International Ltd. Company.
c. Spirax Sarco, Inc.
d. Watts Water Technologies, Inc.

2. Disc Material: Forged copper alloy with bronze nozzle.
3. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
4. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded or flanged inlet, outlet, and drain, with threads complying with ASME B1.20.1.
7. Exhaust Head: Cast iron and having threaded or flanged inlet and drain, with threads complying with ASME B1.20.1.
8. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.9 PRESSURE-REDUCING VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong International, Inc.
2. Hoffman Specialty; Division of ITT Industries.
3. Leslie Controls, Inc.
4. Spence Engineering Company, Inc.
5. Spirax Sarco, Inc.

B. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.

C. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.

D. Body: Cast iron.

E. End Connections: Threaded connections for valves NPS 2 and smaller and flanged connections for valves NPS 2-1/2 and larger.

F. Trim: Hardened stainless steel.

G. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.

H. Gaskets: Non-asbestos materials.

I. Capacities and Characteristics: Refer to Drawings for Steam Pressure Reducing Valve Schedule.

2.10 STEAM TRAPS

A. Float and Thermostatic Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. Hoffman Specialty; Division of ITT Industries.
    c. Spirax Sarco, Inc.

2. Body and Bolted Cap: ASTM A 126, cast iron.
3. End Connections: Threaded.
4. Float Mechanism: Replaceable, stainless steel.
5. Head and Seat: Hardened stainless steel.
6. Trap Type: Balanced pressure.
7. Thermostatic Bellows: Stainless steel or monel.
8. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
10. Maximum Operating Pressure: 125 psig.

B. Inverted Bucket Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. Hoffman Specialty; Division of ITT Industries.
    c. Spirax Sarco, Inc.

2. Body and Cap: Cast iron.
3. End Connections: Threaded.
4. Head and Seat: Stainless steel.
5. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
6. Bucket: Brass or stainless steel.
7. Strainer: Integral stainless-steel inlet strainer within the trap body.
8. Air Vent: Stainless-steel thermostatic vent.
9. Pressure Rating: 250 psig.

2.11 THERMOSTATIC AIR VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. Hoffman Specialty; Division of ITT Industries.
   c. Spirax Sarco, Inc.

B. Body: Cast iron, bronze or stainless steel.

C. End Connections: Threaded.

D. Float, Valve, and Seat: Stainless steel.

E. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.

F. Pressure Rating: 125 psig.

G. Maximum Temperature Rating: 350 deg F.

2.12 VACUUM BREAKERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. Hoffman Specialty; Division of ITT Industries.
   c. Spirax Sarco, Inc.

2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
5. O-ring Seal: EPR.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

2.13 STEAM METERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EMCO Flow Systems; Division of Advanced Energy Company.
2. Preso Meters; a division of Racine Federated Inc.
3. Spirax Sarco, Inc.

B. Meters shall have a microprocessor to display totalizer flow, flow rate, temperature, pressure, time, and date; alarms for high and low flow rate and temperature.

1. Computer shall have 4 to 20-mA or 2 to 10volt output for temperature, pressure, and contact closure for flow increments.
2. Independent timers to store four peak flow rates and total flow.
3. Interface compatible with central workstation described in Division 23 Section "Instrumentation and Control for HVAC."
4. Microprocessor Enclosure: NEMA 250, Type 4.

C. Sensor: Venturi, of stainless-steel construction, for insertion in pipeline between flanges. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

D. Sensor: Vortex type with stainless-steel wetted parts and wafer or flange connections; and with a piezoelectric sensor removable and serviceable without shutting down the process. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

E. Sensor: Spring-loaded, variable-area flowmeter type; density compensated with stainless-steel wetted parts and wafer or flange connections. At least 10:1 turndown with plus or minus 2 percent accuracy over full-flow range.

2.14 CONDENSATE METERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Central Station Steam Co.
2. Lincoln Meter Company.

B. Body: Cast iron, bronze, or brass.

C. Turbine: Copper, brass, or stainless steel.

D. Connections: Threaded for NPS 2 and smaller and flanged for NPS 2-1/2.

E. Totalizer: Meters shall have a microprocessor to display flow, flow rate, time, and date; alarms for high and low flow rate, pressure, and temperature.

1. Computer shall have 4- to 20-mA or 2- to 10-volt output for temperature, pressure, and contact closure for flow increments.
2. Independent timers to store four peak flow rates and total flow.

3. Interface compatible with central workstation specified in Division 23 Section "Instrumentation and Control for HVAC."
4. Microprocessor Enclosure: NEMA 250, Type 4.

F. Pressure Rating: 15 psig.

G. Maximum Temperature Rating: 250 deg F.

2.15 EXHAUST VENT HEADS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spirax Sarco

B. Constructed of austenitic stainless steel with internal baffle to separate entrained water from steam discharge.

C. Provide vent heads with threaded or flanged connections.

D. Provide unit with threaded drain connection.

2.16 MUFFLING ORIFICE PLATES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spence Engineering Co.

B. Constructed of a steel plate with a stainless steel plate welded to the primary plate and designed to fit between two ANSI flanges.

C. Unit shall be designed to provide 6-10 dBa noise reduction in the steam line.

2.17 NOISE SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spence Engineering Co.

B. Constructed of welded steel with stainless steel acoustic material. Provide with Class 150 flanged end connections.

C. Units shall be designed to provide 10 – 28 dBa noise reduction in the steam line.

PART 3 - EXECUTION

3.1 LOW PRESSURE STEAM SYSTEMS

A. Low Pressure Steam: NPS 2 and Smaller: Standard weight, ASTM A53, Type "S, E, or F". Grade A or B, black steel pipe; ASTM A126/ANSI B16.4 Class 300 Malleable Iron; threaded joints. 3000# Forged Steel, threaded or socket weld fittings

B. Low Pressure Steam: NPS 2-1/2 and Larger: Standard weight, ASTM A53, Type "E" or "F", Grade A or B or Type "S", Grade B, black steel pipe; ASTM A234 Class 150 seamless or EWR, carbon steel weld fittings.

C. Low Pressure Condensate: NPS 2 and Smaller: Extra strong ASTM A53, Type "E", "F" or "S", Grade A or B black steel pipe; ASTM A126/ANSI B16.4 Class 300 Malleable Iron; threaded joints. 3000# Forged Steel, threaded or socket weld fittings.

D. Low Pressure Condensate: NPS 2-1/2 and Larger: Extra strong ASTM A53, Grade "B", Type "E" or Type "S" black steel pipe; ASTM A234 Class 300 seamless, carbon steel weld fittings.

3.2 HIGH PRESSURE STEAM SYSTEMS (16 PSIG – 80 PSIG)

A. High Pressure Steam: NPS 2 and Smaller: Standard weight, ASTM A53, Grade "B" Type "S" black steel pipe; ASTM A126/ANSI B16.4 Class 300 Malleable Iron; threaded joints. 3000# Forged Steel, threaded or socket weld fittings.

B. High Pressure Steam: NPS 2-1/2 and Larger: Standard weight, ASTM A53, Type "E" or Type "S", Grade B, black steel pipe; ASTM A234 Class 150 seamless, carbon steel weld fittings.

C. High Pressure Condensate: NPS 2 and Smaller: Extra strong ASTM A53, Grade "B", Type "S" black steel pipe; ASTM A126/ANSI B16.4 Class 300 Malleable Iron; threaded joints. 3000# Forged Steel, threaded or socket weld fittings.

D. High Pressure Condensate: NPS 2-1/2 and Larger: Extra strong ASTM A53, Grade "B", Type "E" or Type "S" black steel pipe; ASTM A234 Class 300 seamless, carbon steel weld fittings.

3.3 ANCILLARY PIPING APPLICATIONS

A. Cold water make-up piping:

1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Boiler Feedwater Piping: Same materials and joining methods as for piping specified for the service in which feedwater piping is installed.

C. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

D. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.

E. Vacuum-Breaker Piping: Outlet, same as service where installed.

F. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.4 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install steam safety-valve discharge drip pan ell fittings with steam vent piping run directly outdoors or as indicated on Drawings. All vent piping to be supported independently from steam safety valves. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.5 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

K. Install drains, consisting of a tee fitting, NPS 3/4 gate valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

N. Reduce pipe sizes on horizontal piping runs using eccentric reducer fitting installed with level side down.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe or 45 degrees from the top of main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Properly align piping before installation of valves. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping on valve ends.

R. Install swing check valves in the horizontal position with the hinge pin level.

S. Install swing check valves where specified and detailed and at steam trap condensate lines where they rise at the outlet of steam traps. Provide isolation valves to allow repair or replacement of check valve.

T. Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal or 45 degrees above horizontal where space limitation does not allow installation in an upright position or where large valves are provided with chain wheel operators.

U. In general, install valves located within six feet (6') of the floor level, out from under equipment, and in accessible locations with adequate clearance around hand wheels or levers for easy operation.

V. Install globe valves for throttling service and control device or meter by-pass.

W. Install quick-opening valves at boiler water level safety switches with drain piping extended down to nearest floor drain.

X. Where valves 2-1/2" and larger are located more than 12'-0" above the finished floor, install valve with stem in the horizontal position and provide a chain wheel operator.

Y. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Z. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

AA. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and gate valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

BB. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

CC. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

DD. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 200 feet.
2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

EE. Flash Tank:

1. Pitch condensate piping down toward flash tank.
2. If more than one condensate pipe discharges into flash tank, install a check valve in each line.
3. Install tank vent connected into low pressure steam main.
4. Install safety valve at tank top. Safety valve set to discharge at same pressure as low pressure system safety valve setting.
5. Install full-port ball valve, and swing check valve on condensate outlet.
6. Install inverted bucket or float and thermostatic trap at low-pressure condensate outlet, sized for three times the calculated heat load.
7. Install pressure gage on low-pressure steam outlet according to Division 23 Section "Meters and Gages for HVAC Piping."

3.6 STEAM-TRAP INSTALLATION

A. Install steam traps in accessible locations as close as possible to connected equipment.

B. For low pressure systems, install gate valve, strainer, and union upstream from trap; install union, test tee with gate valve and gate valve downstream from trap unless otherwise indicated.

C. For high pressure systems, install gate valve, strainer, and union upstream from trap; install union, test tee with gate valve, check valve and gate valve downstream from trap unless otherwise indicated.

3.7 PRESSURE-REDUCING VALVE INSTALLATION

A. Install pressure-reducing valves in accessible location for maintenance and inspection.

B. Install bypass piping around pressure-reducing valves, with globe valve Cv selected such that the pressure drop across the wide open globe valve is equal to the upstream steam pressure minus the downstream steam pressure when steam is flowing through the globe valve at the design maximum steam flow through the larger pressure reducing valve (for duplex valve stations).

C. Install gate valves on both sides of pressure-reducing valves.

D. Install eccentric reducers both upstream and downstream of pressure reducing valves, with the eccentric reducers oriented to create a level flow path from the upstream and downstream piping through the pressure reducing valve.

E. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.

F. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 23 Section "Meters and Gages for HVAC Piping."

G. Install strainers upstream for pressure-reducing valve.

H. Install safety valve downstream from pressure-reducing valve station and at locations detailed.

I. Avoid locating steam traps below the level of low pressure condensate return mains. Provide a condensate pumping unit to lift condensate to drain into the low pressure condensate return main if the low pressure steam trap is located below the condensate return main.

3.8 STEAM OR CONDENSATE METER INSTALLATION

A. Install meters with lengths of straight pipe upstream and downstream according to meter manufacturer's instructions.

B. Provide data acquisition wiring. Refer to Division 23 Section "Instrumentation and Control for HVAC."

C. Install eccentric reducers both upstream and downstream of steam flow meters with the eccentric reducers oriented to create a level flow path from the upstream and downstream piping through the steam flow meter. If the steam flow meters are constructed with integral concentric pipe reduction, provide a drip leg and trap upstream of the meter to collect any liquid condensate before it blows through the meter.

3.9 SAFETY VALVE INSTALLATION

A. Install safety valves according to ASME B31.9, "Building Services Piping."

B. Install steam safety-valve discharge drip pan elbow fittings with steam vent piping run vertically directly outdoors or as indicated on Drawings. All vent piping to be supported independently from steam safety valves.

C. Install drip-pan elbow fitting adjacent to safety valve and pipe

D. Pipe drip pan elbow drain connection to nearest floor drain.

3.10 HANGERS AND SUPPORTS

A. Install hangers and supports according to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing.

B. Comply with mounting and anchoring requirements for seismic installations. Seismic restraints are specified in Division 23 Section "Seismic Restraint for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

D. Install hangers with the following maximum spacing and minimum rod sizes:

1. NPS 3/4through NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
2. NPS 1-1/2 through NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
3. NPS 4 through NPS 6 Maximum span, 10 feet; minimum rod size, 1/2 inch.
4. NPS 8: Maximum span, 14 feet; minimum rod size, 5/8 inch.
5. NPS 10: Maximum span, 14 feet; minimum rod size, 3/4 inch.
6. NPS 12: Maximum span, 14 feet; minimum rod size, 7/8 inch.
7. NPS 14: Maximum span, 20 feet; minimum rod size, 1 inch.
8. NPS 16: Maximum span, 20 feet; minimum rod size, 1 inch.
9. NPS 18: Maximum span, 20 feet; minimum rod size, 1-1/4 inches.
10. NPS 20: Maximum span, 20 feet; minimum rod size, 1-1/4 inches.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.11 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Mitered ells, notched tees, and “orange peel” reducers are not acceptable. On threaded piping, bushings are not acceptable.

G. “Weldolets” and “Threadotlets” may be used for branch takeoffs up to one half (1/2) the diameter of the main.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.12 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install traps Y-strainers and control valves in accessible locations close to connected equipment.

C. Install a minimum of two elbows in the pipe line connecting to terminal equipment to provide flexibility for expansion and contraction of the piping system.

D. Install offsets in terminal device pipe connections to allow for service and replacement of the terminal device

E. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required. Select the bypass globe valve with a Cv such that the pressure drop across the bypass valve wide open is equal to the pressure drop across the controlv valve when it is wide open.

F. Install vacuum breakers downstream from control valve, close to coil inlet connection or heat exchanger body.

G. Install a drip leg with steam trap upstream of the control valve at coil inlet. Provide a Y-strainer located upstream from the control vavle

3.13 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Perform the following tests on steam and condensate piping:

1. Use ambient temperature city water as a testing medium unless there is risk of damage due to freezing.
2. Subject piping system to hydrostatic test pressure listed below, but not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.

System	Test Pressure
Low Pressure Steam (0 psig – 15 psig)	100 psig
Low Pressure Condensate (0 psig – 15 psig)	100 psig
High Pressure Steam (16 psig – 100 psig)	150 psig
High Pressure Condensate (16 psig – 100 psig)	150 psig
Condensate Pump Discharge	100 psig

3. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks. Caulking of joints will not be acceptable.

C. Prepare written report of testing.

END OF SECTION 23 2213

SECTION 23 2213 - STEAM AND CONDENSATE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for LP and HP steam and condensate piping:

1. Pipe and fittings.
2. Strainers.
3. Flash tanks.
4. Safety valves.
5. Pressure-reducing valves.
6. Steam traps.
7. Thermostatic air vents
8. Vacuum breakers.
9. Steam and condensate meters.
10. Exhaust vent heads.
11. Muffling orifice plates.
12. Noise suppressors.

1.3 DEFINITIONS

A. HP Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.

B. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. HP Steam Piping: 16 to 80 psig 125 psig
2. LP Steam Piping: 15 psig
3. Low Pressure Condensate Piping: 15 psigat 340 deg F.
4. High Pressure Condensate Piping (16 PSIG – 100 PSIG): 150 psigat 365 deg F
5. Pumped Condensate: 100 psigat 225 deg F.
6. Cold Water Make-up Piping: 80 psig at 150 deg F.
7. Boiler Feedwater Piping: Equal to 150 percent of the piping system pressure to which it is attached.

8. Boiler Blowdown Piping: Equal to pressure of the piping system to which it is attached.
9. Drain Piping: Equal to pressure of the piping system to which it is attached.
10. Boiler Trim Piping: Equal to pressure of the piping system to which it is attached.
11. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
12. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe and fittings.
2. Strainers.
3. Flash tanks.
4. Safety valves.
5. Pressure-reducing valves.
6. Steam traps.
7. Thermostatic air vents
8. Vacuum breakers.
9. Steam and condensate meters.
10. Exhaust vent heads.
11. Steam filter – Element type.
12. Steam separators.
13. Muffling orifice plates.
14. Noise suppressors.

B. Shop Drawings: Detail, [1/4 inch equals 1 foot] scale, flash tank assemblies and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.

C. Qualification Data: For Installer.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify processes and operators according to the following:

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.

B. Steel Pipe: ASTM A 106, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.

C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 add 150 as indicated in Part 3 piping applications articles.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.

E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.

F. Wrought Carbon Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Carbon Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised or flat face.

H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.2 BELOW GRADE STEAM PIPING AND CONDENSATE RETURN PIPING

A. Manufacturers

1. Perma-Pipe “Multi-Therm 500” or Ultratherm
2. Thermacor “Duo-Therm 505”

3. Rovanco "Hi-Temp Rhinocoat Conduit or Hi-Temp System"

B. Description: All underground heat distribution lines shall be insulated jacketed steel conduit or 20 mil fusion epoxy coated steel jacketed conduit.

1. All straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions, and designed to minimize the number of field welds.
2. Each system layout shall be computer analyzed by the piping system manufacturer to determine stresses and movements of the service pipe. These calculations shall account for the interaction and movement of the existing pipe to create one piping system, fully integrated.
3. The system design shall be in strict conformance with ANSI B31.1 latest edition, and stamped by a registered professional engineer.

C. Service Pipe:

1. Steam pipe shall be Standard weight carbon steel pipe, ASTM A53 Grade B, EWR.
2. Condensate piping shall be extra heavy carbon steel, ASTM A106 Grade B or ASTM A53 Grade B.
3. Butt welded joints 2.5 inches and larger
4. Socket welded for 2 inches and below.
5. Where possible, straight sections shall be supplied in 40 foot random length with 6 inches of piping exposed at each end for field joint fabrication.
6. Buried steam pipe and pipe inside exterior vaults shall be standard weight carbon steel, ASTM A53 Grade B, EWR.
7. Buried steam condensate pipe and pipe inside exterior vaults shall be extra heavy carbon steel, ASTM A53 Grade B, EWR.

D. Subassemblies:

1. End seals, gland seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the system.
2. All subassemblies shall be designed to allow for complete draining and drying of the conduit system.

E. Service Pipe Insulation:

1. Insulation shall be Aerogel, calcium silicate, mineral wool, or calcium silicate insulation as an option.
2. The insulation shall be secured to the pipe by stainless steel bands. Insulation thickness shall be as shown on the drawings.

F. Outer Conduit:

1. The steel conduit casing shall be smooth wall, welded steel conduit of the thickness specified below:

Conduit Size	Conduit Thickness

6" - 26"	10 Gauge
28" - 36"	6 Gauge
38" - 42"	4 Gauge

G. Leak Detection:

1. Leak detection is not required on buried steam or steam condensate piping.

H. Pipe Supports:

1. All pipes within the outer casing shall be supported at not more than 10 foot intervals. These supports shall be designed to allow for continuous airflow and drainage of the conduit in place. The straight supports shall be designed to occupy not more than 10% of the annular air space. Supports shall be of the type where insulation thermally isolates the carrier pipe from the outer conduit.
2. The surface of the insulation shall be protected at the support by a sleeve not less than 12 inches long, fitted with traverse and, where required, rotational arresters.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
c. Flexible metallic gaskets (Flexitallic or equal) may be used.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.4 VALVES

A. Ball Valve:

1. Class 300 Steel Ball Valves with Full Port and Stainless-Steel Trim:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Conbraco Industries, Inc. Apollo 88A-900 Series

2) Jamesbury; Metso.
3) NIBCO INC., Model F-535-CS-F-66-FS

b. Description:
1) Standard: MSS SP-72.
2) CWP Rating: 720 psig.
3) Body Design: Split body.
4) Body Material: Carbon steel, ASTM A 216, Type WCB.
5) Ends: Flanged.
6) Seats: PTFE.
7) Stem: Stainless steel.
8) Ball: Stainless steel, vented.
9) Port: Full.

B. Check Valve:

1. Class 150, Bronze Swing Check Valves with Bronze Disc:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Milwaukee Valve Company.
2) NIBCO INC.
3) Stockham; Crane Energy Flow Solutions.
b. Description:
1) Standard: MSS SP-80, Type 3.
2) CWP Rating: 300 psig.
3) Body Design: Horizontal flow.
4) Body Material: ASTM B 62, bronze.
5) Ends: Threaded.
6) Disc: Bronze.

C. Gate Valve:

1. Class 125, OS&Y, Iron Gate Valves:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Jenkins Valves; Crane Energy Flow Solutions.
2) Milwaukee Valve Company, F-2894-M
3) NIBCO INC.
4) Powell Valves.
5) Stockham; Crane Energy Flow Solutions.
b. Description:
1) Standard: MSS SP-70, Type I.
2) NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
3) NPS 14 to NPS 24, CWP Rating: 150 psig.
4) Body Material: ASTM A 126, gray iron with bolted bonnet.
5) Ends: Flanged.
6) Trim: Bronze.
7) Disc: Solid wedge.
8) Packing and Gasket: Asbestos free.
c. Valve in exterior vaults
1) Epoxy coated exterior body

D. Stop-Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.
   b. Jenkins Valves; a Crane Company.
   c. Lunkenheimer Valves.
   d. A.Y. McDonald Mfg. Co.

2. Body and Bonnet: Malleable iron.
3. End Connections: Flanged.
4. Disc: Cylindrical with removable liner and machined seat.
5. Stem: Brass alloy.
6. Operator: Outside screw and yoke with cast-iron handwheel.
7. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
8. Pressure Class: 250.

2.5 STRAINERS FOR LOW PRESSURE STEAM SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong International
2. Hoffman Specialty
3. Mueller Steam Specialties
4. O.C. Keckley Co.
5. Spirax Sarco

B. Y-Pattern Strainers:

1. NPS 2 and Smaller:

   a. Body: ASTM A 126, Class B cast iron with bolted cover and bottom drain connection.
   b. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
   c. Strainer Screen: Stainless-steel, 60 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
   d. Tapped blowoff plug.
   e. CWP Rating: 250-psig working steam pressure.

2. NPS 2-1/2 and Larger:

   a. Body: ASTM A 126, Class B cast iron with bolted cover and bottom drain connection.

b. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
c. Strainer Screen: Stainless-steel, 60 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
d. Tapped blowoff plug.
e. CWP Rating: 250-psig working steam pressure.

2.6 STRAINERS FOR HIGH PRESSURE STEAM SYSTEMS (16 PSIG – 80 PSIG)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong International
2. Hoffman Specialty
3. Mueller Steam Specialties
4. O.C. Keckley Co.
5. Spirax Sarco

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 60 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig working steam pressure.

2.7 FLASH TANKS

A. Shop or factory fabricated of welded steel according to ASME Boiler and Pressure Vessel Code, for 150-psig rating; and bearing ASME label. Fabricate with tappings for low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs.

2.8 SAFETY VALVES

A. Bronze or Brass Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Kunkle Valve; a Tyco International Ltd. Company.
c. Spirax Sarco, Inc.
d. Watts Water Technologies, Inc.

2. Disc Material: Forged copper alloy.

3. End Connections: Threaded inlet and outlet.
4. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded or flanged inlet and outlet connections.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Cast-Iron Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. Kunkle Valve; a Tyco International Ltd. Company.
   c. Spirax Sarco, Inc.
   d. Watts Water Technologies, Inc.

2. Disc Material: Forged copper alloy with bronze nozzle.
3. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
4. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded or flanged inlet, outlet, and drain, with threads complying with ASME B1.20.1.
7. Exhaust Head: Cast iron and having threaded or flanged inlet and drain, with threads complying with ASME B1.20.1.
8. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.9 PRESSURE-REDUCING VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong International, Inc.
2. Hoffman Specialty; Division of ITT Industries.
3. Leslie Controls, Inc.
4. Spence Engineering Company, Inc.
5. Spirax Sarco, Inc.

B. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.

C. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.

D. Body: Cast iron.

E. End Connections: Threaded connections for valves NPS 2 and smaller and flanged connections for valves NPS 2-1/2 and larger.

F. Trim: Hardened stainless steel.

G. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.

H. Gaskets: Non-asbestos materials.

I. Capacities and Characteristics: Refer to Drawings for Steam Pressure Reducing Valve Schedule.

2.10 STEAM TRAPS

A. Float and Thermostatic Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. Hoffman Specialty; Division of ITT Industries.
    c. Spirax Sarco, Inc.

2. Body and Bolted Cap: ASTM A 126, cast iron.
3. End Connections: Threaded.
4. Float Mechanism: Replaceable, stainless steel.
5. Head and Seat: Hardened stainless steel.
6. Trap Type: Balanced pressure.
7. Thermostatic Bellows: Stainless steel or monel.
8. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
10. Maximum Operating Pressure: 125 psig.

B. Inverted Bucket Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. Hoffman Specialty; Division of ITT Industries.
    c. Spirax Sarco, Inc.

2. Body and Cap: Cast iron.
3. End Connections: Threaded.
4. Head and Seat: Stainless steel.
5. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.

6. Bucket: Brass or stainless steel.
7. Strainer: Integral stainless-steel inlet strainer within the trap body.
8. Air Vent: Stainless-steel thermostatic vent.
9. Pressure Rating: 250 psig.

2.11 THERMOSTATIC AIR VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. Hoffman Specialty; Division of ITT Industries.
   c. Spirax Sarco, Inc.

B. Body: Cast iron, bronze or stainless steel.

C. End Connections: Threaded.

D. Float, Valve, and Seat: Stainless steel.

E. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.

F. Pressure Rating: 125 psig.

G. Maximum Temperature Rating: 350 deg F.

2.12 VACUUM BREAKERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. Hoffman Specialty; Division of ITT Industries.
   c. Spirax Sarco, Inc.

2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
5. O-ring Seal: EPR.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

2.13 STEAM METERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. EMCO Flow Systems; Division of Advanced Energy Company.

2. Preso Meters; a division of Racine Federated Inc.
3. Spirax Sarco, Inc.

B. Meters shall have a microprocessor to display totalizer flow, flow rate, temperature, pressure, time, and date; alarms for high and low flow rate and temperature.

1. Computer shall have 4 to 20-mA or 2 to 10 volt output for temperature, pressure, and contact closure for flow increments.
2. Independent timers to store four peak flow rates and total flow.
3. Interface compatible with central workstation described in Division 23 Section "Instrumentation and Control for HVAC."
4. Microprocessor Enclosure: NEMA 250, Type 4.

C. Sensor: Venturi, of stainless-steel construction, for insertion in pipeline between flanges. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

D. Sensor: Vortex type with stainless-steel wetted parts and wafer or flange connections; and with a piezoelectric sensor removable and serviceable without shutting down the process. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

E. Sensor: Spring-loaded, variable-area flowmeter type; density compensated with stainless-steel wetted parts and wafer or flange connections. At least 10:1 turndown with plus or minus 2 percent accuracy over full-flow range.

2.14 CONDENSATE METERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Central Station Steam Co.
2. Lincoln Meter Company.

B. Body: Cast iron, bronze, or brass.

C. Turbine: Copper, brass, or stainless steel.

D. Connections: Threaded for NPS 2 and smaller and flanged for NPS 2-1/2.

E. Totalizer: Meters shall have a microprocessor to display flow, flow rate, time, and date; alarms for high and low flow rate, pressure, and temperature.

1. Computer shall have 4- to 20-mA or 2- to 10-volt output for temperature, pressure, and contact closure for flow increments.
2. Independent timers to store four peak flow rates and total flow.
3. Interface compatible with central workstation specified in Division 23 Section "Instrumentation and Control for HVAC."
4. Microprocessor Enclosure: NEMA 250, Type 4.

F. Pressure Rating: 15 psig.

G. Maximum Temperature Rating: 250 deg F.

2.15 EXHAUST VENT HEADS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spirax Sarco

B. Constructed of austenitic stainless steel with internal baffle to separate entrained water from steam discharge.

C. Provide vent heads with threaded or flanged connections.

D. Provide unit with threaded drain connection.

2.16 MUFFLING ORIFICE PLATES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spence Engineering Co.

B. Constructed of a steel plate with a stainless steel plate welded to the primary plate and designed to fit between two ANSI flanges.

C. Unit shall be designed to provide 6-10 dBa noise reduction in the steam line.

2.17 NOISE SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spence Engineering Co.

B. Constructed of welded steel with stainless steel acoustic material. Provide with Class 150 flanged end connections.

C. Units shall be designed to provide 10 – 28 dBa noise reduction in the steam line.

PART 3 - EXECUTION

3.1 LOW PRESSURE STEAM SYSTEMS

A. Low Pressure Steam: NPS 2 and Smaller: Standard weight, ASTM A53, Type “F” black steel pipe; ASTM A126/ANSI B16.4 Class 125 cast-iron fittings; threaded joints.

B. Low Pressure Steam: NPS 2-1/2 and Larger: Standard weight, ASTM A53, Type "E" or Type "S", Grade B, black steel pipe; ASTM A234 Class 150 seamless, carbon steel weld fittings.

C. Low Pressure Condensate: NPS 2 and Smaller: Extra strong ASTM A53, Type "F" black steel pipe; ASTM A126/ANSI B16.4 Class 125 cast-iron fittings; threaded joints.

D. Low Pressure Condensate: NPS 2-1/2 and Larger: Extra strong ASTM A53, Grade "B", Type "E" or Type "S" black steel pipe; ASTM A234 minimum Class 150 seamless, carbon steel weld fittings.

3.2 HIGH PRESSURE STEAM SYSTEMS (16 PSIG – 80 PSIG)

A. High Pressure Steam: NPS 2 and Smaller: Standard weight, ASTM A53, Grade "B" Type "S" black steel pipe; ASTM A126/ANSI B16.4 Class 125 cast-iron fittings; threaded joints.

B. High Pressure Steam: NPS 2-1/2 and Larger: Standard weight, ASTM A53, Type "E" or Type "S", Grade B, black steel pipe; ASTM A234 Class 150 seamless, carbon steel weld fittings.

C. High Pressure Condensate: NPS 2 and Smaller: Extra strong ASTM A53, Grade "B", Type "S" black steel pipe; ASTM A126/ANSI B16.4 Class 125 cast-iron fittings; threaded joints.

D. High Pressure Condensate: NPS 2-1/2 and Larger: Extra strong ASTM A53, Grade "B", Type "E" or Type "S" black steel pipe; ASTM A234 Class 300 seamless, carbon steel weld fittings.

3.3 ANCILLARY PIPING APPLICATIONS

A. Cold water make-up piping:

1. Drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Boiler Feedwater Piping: Same materials and joining methods as for piping specified for the service in which feedwater piping is installed.

C. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

D. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.

E. Vacuum-Breaker Piping: Outlet, same as service where installed.

F. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.4 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install steam safety-valve discharge drip pan ell fittings with steam vent piping run directly outdoors or as indicated on Drawings. All vent piping to be supported independently from steam safety valves. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.5 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

K. Install drains, consisting of a tee fitting, NPS 3/4 gate valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

N. Reduce pipe sizes on horizontal piping runs using eccentric reducer fitting installed with level side down.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe or 45 degrees from the top of main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Properly align piping before installation of valves. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping on valve ends.

R. Install swing check valves in the horizontal position with the hinge pin level.

S. Install swing check valves where specified and detailed and at steam trap condensate lines where they rise at the outlet of steam traps. Provide isolation valves to allow repair or replacement of check valve.

T. Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal or 45 degrees above horizontal where space limitation does not allow installation in an upright position or where large valves are provided with chain wheel operators.

U. In general, install valves located within six feet (6') of the floor level, out from under equipment, and in accessible locations with adequate clearance around hand wheels or levers for easy operation.

V. Install globe valves for throttling service and control device or meter by-pass.

W. Install quick-opening valves at boiler water level safety switches with drain piping extended down to nearest floor drain.

X. Where valves 2-1/2" and larger are located more than 12'-0" above the finished floor, install valve with stem in the horizontal position and provide a chain wheel operator.

Y. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Z. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

AA. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and gate valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

BB. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

CC. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

DD. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 200 feet.
2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

EE. Flash Tank:

1. Pitch condensate piping down toward flash tank.
2. If more than one condensate pipe discharges into flash tank, install a check valve in each line.
3. Install tank vent connected into low pressure steam main.
4. Install safety valve at tank top. Safety valve set to discharge at same pressure as low pressure system safety valve setting.
5. Install full-port ball valve, and swing check valve on condensate outlet.
6. Install inverted bucket or float and thermostatic trap at low-pressure condensate outlet, sized for three times the calculated heat load.
7. Install pressure gage on low-pressure steam outlet according to Division 23 Section "Meters and Gages for HVAC Piping."

3.6 STEAM-TRAP INSTALLATION

A. Install steam traps in accessible locations as close as possible to connected equipment.

B. For low pressure systems, install gate valve, strainer, and union upstream from trap; install union, test tee with gate valve and gate valve downstream from trap unless otherwise indicated.

C. For high pressure systems, install gate valve, strainer, and union upstream from trap; install union, test tee with gate valve, check valve and gate valve downstream from trap unless otherwise indicated.

3.7 PRESSURE-REDUCING VALVE INSTALLATION

A. Install pressure-reducing valves in accessible location for maintenance and inspection.

B. Install bypass piping around pressure-reducing valves, with globe valve Cv selected such that the pressure drop across the wide open globe valve is equal to the upstream steam pressure minus the downstream steam pressure when steam is flowing through the globe valve at the design maximum steam flow through the larger pressure reducing valve (for duplex valve stations).

C. Install gate valves on both sides of pressure-reducing valves.

D. Install eccentric reducers both upstream and downstream of pressure reducing valves, with the eccentric reducers oriented to create a level flow path from the upstream and downstream piping through the pressure reducing valve.

E. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.

F. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 23 Section "Meters and Gages for HVAC Piping."

G. Install strainers upstream for pressure-reducing valve.

H. Install safety valve downstream from pressure-reducing valve station and at locations detailed.

I. Avoid locating steam traps below the level of low pressure condensate return mains. Provide a condensate pumping unit to lift condensate to drain into the low pressure condensate return main if the low pressure steam trap is located below the condensate return main.

3.8 STEAM OR CONDENSATE METER INSTALLATION

A. Install meters with lengths of straight pipe upstream and downstream according to meter manufacturer's instructions.

B. Provide data acquisition wiring. Refer to Division 23 Section "Instrumentation and Control for HVAC."

C. Install eccentric reducers both upstream and downstream of steam flow meters with the eccentric reducers oriented to create a level flow path from the upstream and downstream piping through the steam flow meter. If the steam flow meters are constructed with integral concentric pipe reduction, provide a drip leg and trap upstream of the meter to collect any liquid condensate before it blows through the meter.

3.9 SAFETY VALVE INSTALLATION

A. Install safety valves according to ASME B31.9, "Building Services Piping."

B. Install steam safety-valve discharge drip pan elbow fittings with steam vent piping run vertically directly outdoors or as indicated on Drawings. All vent piping to be supported independently from steam safety valves.

C. Install drip-pan elbow fitting adjacent to safety valve and pipe

D. Pipe drip pan elbow drain connection to nearest floor drain.

3.10 HANGERS AND SUPPORTS

A. Install hangers and supports according to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing.

B. Comply with mounting and anchoring requirements for seismic installations. Seismic restraints are specified in Division 23 Section "Seismic Restraint for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

D. Install hangers with the following maximum spacing and minimum rod sizes:

1. NPS 3/4through NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
2. NPS 1-1/2 through NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
3. NPS 4 through NPS 6 Maximum span, 10 feet; minimum rod size, 1/2 inch.
4. NPS 8: Maximum span, 14 feet; minimum rod size, 5/8 inch.
5. NPS 10: Maximum span, 14 feet; minimum rod size, 3/4 inch.
6. NPS 12: Maximum span, 14 feet; minimum rod size, 7/8 inch.
7. NPS 14: Maximum span, 20 feet; minimum rod size, 1 inch.
8. NPS 16: Maximum span, 20 feet; minimum rod size, 1 inch.
9. NPS 18: Maximum span, 20 feet; minimum rod size, 1-1/4 inches.
10. NPS 20: Maximum span, 20 feet; minimum rod size, 1-1/4 inches.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.11 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Mitered ells, notched tees, and “orange peel” reducers are not acceptable. On threaded piping, bushings are not acceptable.

G. "Weldolets" and "Threadotlets" may be used for branch takeoffs up to one half (1/2) the diameter of the main.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.12 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install traps Y-strainers and control valves in accessible locations close to connected equipment.

C. Install a minimum of two elbows in the pipe line connecting to terminal equipment to provide flexibility for expansion and contraction of the piping system.

D. Install offsets in terminal device pipe connections to allow for service and replacement of the terminal device

E. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required. Select the bypass globe valve with a Cv such that the pressure drop across the bypass valve wide open is equal to the pressure drop across the controlv valve when it is wide open.

F. Install vacuum breakers downstream from control valve, close to coil inlet connection or heat exchanger body.

G. Install a drip leg with steam trap upstream of the control valve at coil inlet. Provide a Y-strainer located upstream from the control vavle

3.13 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Perform the following tests on steam and condensate piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing.

2. Subject piping system to hydrostatic test pressure listed below, but not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.

System	Test Pressure
Low Pressure Steam (0 psig – 15 psig)	100 psig
Low Pressure Condensate (0 psig – 15 psig)	100 psig
High Pressure Steam (16 psig – 100 psig)	150 psig
High Pressure Condensate (16 psig – 100 psig)	150 psig
Condensate Pump Discharge	100 psig

3. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks. Caulking of joints will not be acceptable.

4. Buried piping may be pre-tested with air at 100 psi. Upon successful test, pipe may be buried and hydrostatically tested at a later date.

C. Prepare written report of testing.

END OF SECTION 23 2213

SECTION 23 2223 - STEAM CONDENSATE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electric-driven steam condensate pumps.

1.3 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated. Indicate pump's operating point on curves. Include receiver capacity and material.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain all electric driven steam condensate pumps through one source from a single manufacturer. Obtain all pressure powered steam condensate pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of steam condensate pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label steam condensate pumps to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store steam condensate pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUPLEX FLOOR MOUNTED ELECTRIC-DRIVEN STEAM CONDENSATE PUMPS

A. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pump(s), controls, and accessories suitable for operation with steam condensate.

B. Configuration: Duplex floor-mounting pumps with receiver and float switches; rated to pump minimum 210 deg F steam condensate.

1. Manufacturers:

a. Nicholson Steam Trap; a division of Spence Engineering Company, Inc.
b. Roth Pump Company.
c. Spence Engineering Company, Inc.; Division of Circor International, Inc.
d. Spirax Sarco, Inc.

2. Receiver: Floor-mounting, close-grained cast iron or welded steel; externally adjustable float switches; with water-level gage, steam condensate thermometer, discharge-pressure gage for each pump, bronze gate valves between receiver and pumps, flanges for pump

mounting, and lifting eyebolts.

3. Inlet Strainer: Cast iron with self-cleaning bronze screen, dirt pocket, and cleanout plug on receiver inlet.
4. Pumps: Centrifugal, close coupled, vertical design, permanently aligned, and bronze fitted; with replaceable bronze case rings, stainless-steel shafts, and mechanical seals; mounted on receiver flanges; rated to operate with a minimum of 2 feet of NPSH.
5. Control Panel: NEMA 250, Type 1 enclosure with hinged door and grounding lug, mounted on pump; factory wired for single external electrical connection; and with the following components within cabinet:

    a. Motor controller for each pump.
    b. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
    c. Manual lead-lag control to override electrical pump alternator to manually select the lead pump.
    d. Momentary contact "TEST" push button on cover for each pump.
    e. Numbered terminal strip.
    f. Disconnect switch.
    g. Fused transformer for control circuit.

6. Capacities and Characteristics: Refer to Condensate Pump Schedule on the Drawings for unit capacities and characteristics.

2.3 BASIN MOUNTED ELECTRIC-DRIVEN STEAM CONDENSATE PUMPS

A. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pump(s), controls, and accessories suitable for operation with steam condensate.

B. Configuration: Underground duplex pump with basin and float switches; rated to pump 200 deg F steam condensate.

1. Manufacturers:
    a. Nicholson Steam Trap; a division of Spence Engineering Company, Inc.
    b. Roth Pump Company.
    c. Spence Engineering Company, Inc.; Division of Circor International, Inc.
    d. Spirax Sarco, Inc.

2. Basin: Cast iron, with hub-type inlets.
3. Basin Cover: Cast iron or steel with gasketed openings for access, pumps, pump shafts, control rods, discharge piping, and vent connections.

    a. Anchor Flange: Cast iron, attached to basin, in location and of size required to anchor basin to concrete slab.

4. Pumps: Wet-pit mounted, vertical, flexible coupled, and suspended.

    a. Casing: Cast iron with open inlet.
    b. Shaft and Bearings: Stainless-steel shaft with oil-lubricated, bronze, intermediate sleeve bearings; 48-inch maximum intervals where basin depth is more than 48 inches; and grease-lubricated, ball-type, thrust bearings.

c. Shaft Couplings: Flexible, capable of absorbing vibration.
d. Seals: Mechanical; with carbon rotating ring, bearing on a ceramic seat held by a stainless-steel spring, and enclosed by a flexible bellows and gasket.
e. Motors: Vertically mounted on cast-iron pedestal.
f. Pump Discharge Piping: Manufacturer's standard steel or bronze pipe, unless otherwise indicated.

5. Control Panel: NEMA 250, Type 1 enclosure with hinged door and grounding lug; mounted on pump; factory wired for single external electrical connection; and with the following components within cabinet:

a. Motor controller for each pump.
b. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
c. Manual lead-lag control to override electrical alternator to manually select the lead pump.
d. Momentary contact "TEST" push button on cover for each pump.
e. Numbered terminal strip.
f. Disconnect switch.
g. Fused transformer for control circuit.

6. Capacities and Characteristics: Refer to Basin Mounted Condensate Pump Schedule on the Drawings for unit capacities and characteristics.

2.4 ELEVATED RECEIVER ELECTRIC-DRIVEN STEAM CONDENSATE PUMPS

A. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pump(s), controls, and accessories suitable for operation with steam condensate.

B. Configuration: Duplex floor-mounting pump with elevated receiver, float switches, and connecting piping; rated to pump 212 deg F steam condensate.

1. Manufacturers:
a. Nicholson Steam Trap; a division of Spence Engineering Company, Inc.
b. Roth Pump Company.
c. Spence Engineering Company, Inc.; Division of Circor International, Inc.
d. Spirax Sarco, Inc.

2. Receiver: Close-grained cast iron or welded steel, mounted on fabricated-steel supports; externally adjustable float switches; with water-level gage, steam condensate thermometer, pump discharge pressure gages, bronze isolation valves between receiver and pumps, and lifting eyebolts.
3. Inlet Strainer: Cast iron with self-cleaning bronze screen, dirt pocket, and cleanout plug on receiver inlet.
4. Pumps: Centrifugal, close coupled, permanently aligned, and bronze fitted; with replaceable bronze case rings, stainless-steel shafts, and mechanical seals; mounted on base below receiver; rated to operate with a minimum of 2 feet of NPSH.
5. Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106; Schedule 80; seamless steel.
6. Fittings NPS 2 and Smaller: ASME B16.1, Class 125 cast iron, threaded.

7. Fittings NPS 2-1/2 and Larger: ASTM A 234/A 234M, extra strong steel, for welded connections.
8. Control Panel: NEMA 250, Type 1 enclosure with hinged door and grounding lug; mounted on pump; factory wired for single external electrical connection; and with the following components within cabinet:

    a. Motor controller for each pump.
    b. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
    c. Manual lead-lag control to override electrical alternator to manually select the lead pump.
    d. Momentary contact "TEST" push button on cover for each pump.
    e. Numbered terminal strip.
    f. Disconnect switch.
    g. Fused transformer for control circuit.

9. Capacities and Characteristics: Refer to Elevated Receiver Condensate Pump Schedule on the Drawings for unit capacities and characteristics.

2.5 PRESSURE-POWERED STEAM CONDENSATE PUMPS

A. Manufacturers:

1. Armstrong Fluid Handling; Div. of Armstrong International, Inc.
2. Nicholson Steam Trap; a division of Spence Engineering Company, Inc.
3. Spence Engineering Company, Inc.; Division of Circor International, Inc.
4. Spirax Sarco, Inc.

B. Description: Factory-fabricated, pressure-powered pumps with mechanical controls, valves, piping connections, and accessories suitable for pumping steam condensate using steam.

C. Configuration: Duplex pump with float-operated valve control.

1. Pump Body: Cast iron.
2. Piping Connections: Threaded; for steam condensate, operating medium, vent, and indicated accessories.
3. Level Gage: Glass site gage with shutoff cocks.
4. Valves: Manufacturer's standard check valves on inlet and outlet.
5. Internal Parts: Stainless-steel float, springs, and actuating mechanism.
6. Valve Seals: Replaceable from exterior.
7. Receiver: Cast iron or welded steel, factory mounted on steel supports; with water-level site glass and threaded piping connections.
8. Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106; Schedule 80; seamless steel.
9. Fittings: ASME B16.1, Class 125 cast iron, threaded.

2.6 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC

Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine rough installation of steam condensate piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps.

D. Install pumps on concrete bases. Anchor pumps to bases using inserts or anchor bolts.

E. Install thermometers and pressure gages.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Install steam supply for pressure-powered pumps as required by Division 23 Section "Steam and Condensate Heating Piping."

D. Install compressed-air supply for pressure-powered pumps as required by Division 22 Section "General-Service Compressed-Air Piping."

E. Install gate and check valves on inlet and outlet of pressure-powered pumps.

F. Install check valve, gate valve, and globe valve at pump discharge connections for each electric-driven pump.

G. Pipe drain to nearest floor drain for overflow and drain piping connections.

H. Install full-size vent piping to outdoors, terminating in 180-degree elbow at point above highest steam system connection or as indicated.

I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

A. Verify that steam condensate pumps are installed and connected according to the Contract Documents.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Clean strainers.

D. Set steam condensate pump controls.

E. Set pump controls for automatic start, stop, and alarm operation.

F. Perform the following preventive maintenance operations and checks before starting:

1. Set float switches to operate at proper levels.
2. Set throttling valves on pump discharge for specified flow.
3. Check motors for proper rotation.
4. Test pump controls and demonstrate compliance with requirements.
5. Replace damaged or malfunctioning pump controls and equipment.
6. Verify that pump controls are correct for required application.

G. Start steam condensate pumps according to manufacturer's written startup instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain steam condensate pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 2223

SECTION 23 2500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-treatment systems for the following:

1. Cleaning of piping systems.
2. Chemical feeder equipment.
3. Treatment for closed systems, heating water systems, clean steam system piping (closed system).

1.2 SUBMITTALS

A. Submit manufacturer's installation instructions.

B. Include data on chemical feeder, procedures, and treatment programs.

C. Include step-by-step instructions on test procedures including target concentrations.

D. Submit product data indicating chemical treatment materials, chemicals, and equipment.

E. Submit reports indicating start-up of treatment and systems are completed and operating properly.

F. Submit reports indicating analysis of system water after cleaning and after treatment.

1.3 QUALITY ASSURANCE

A. University's Representative Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable codes for addition of non- potable chemicals to building mechanical systems, and for delivery to public sewage systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the specified manufacturers.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 MATERIALS

A. System Cleaner:

1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tripoly phosphate and sodium molybdate.
2. Algaecide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.
3. Or equal.

2.3 CHEMICAL FEEDING EQUIPMENT

A. Bypass Feeders: Cast iron or steel, for introducing chemicals into system; with funnel shutoff valve on top, air-release valve on top, drain valve on bottom, and recirculating shutoff valves on sides, as manufactured by Wingert, Nalco, Neptune, or equal.

1. Capacity: 1.8 gal.
2. Working Pressure: 125 psig.

B. Chemical Feed Tanks:

1. Chemical pot feeders shall be provided at each secondary heating system for buildings with HTW heat exchangers, and in stand-alone buildings for chilled water cooling systems and heating water systems.
2. Chemical feeders are not necessary when connecting to the campus chilled water or high temperature water systems.
3. Provide a minimum of a two-gallon by-pass chemical feed tank. Tank shall be piped on discharge piping to pump, across the pump shut-off valve. This location is to eliminate chemical slugging of pump seals. Chemicals shall be circulated throughout the total system before reaching pump seals.

C. Automatic Feedwater System:

1. Feedwater systems shall have totaling water meters on the inlet line.

2. Verify water pressure at the feedwater system. Feed pressure at the inlet shall exceed the manufacturer's recommended pressure by 20%.
3. Automatic blow down and chemical feed systems shall maintain a desired level of dissolved solids concentration in the water of the shell side of HTW steam generators with the use of a Lakewood conductivity controller or equal.
4. Provide a Lakewood model 250 conductivity controller or equal by Moore Controls with a Worchester motorized ball valve and orifice union.
5. The chemical feed system shall include a LMI model chemical feed pump and tank assembly, complete with foot valve, check valve, pressure relief valve, and strainer. The system shall be mounted over a non-metallic 5-gallon chemical mixing tank, complete with agitator, low level switch, hinged tank cover, and suction assembly. The chemical feed tank shall have soft water for mixing.
6. Both the solenoid valve (located on the airline controlling the regulator valve) and the chemical feed pump shall be wired into the steam generator's level controller. When the steam generator calls for water, the chemical feed pump and blow down system will begin operation (only upon activation of the make-up feed system). This system shall stop operation when the make-up valve serving the steam generator is closed. Blow down system shall periodically operate to sample the solids level.
7. Condenser water chemical treatment shall utilize a controller designed to continuously protect the condenser water system from the harmful affects of scaling, corrosion, and microbiological growth. The controller shall operate via microprocessor technology and shall be Pulsa Feeder PULSAtrol or prior approved equal. Fully isolated differential inputs for circuits to prevent ground loops. Keyboard activated hand/off/auto control of relays. The controller shall include:

    a. High resolution 10 bit A/D converter with adjustable analog sample sensitivity for accurate sensor inputs.
    b. Control of conductivity (user selectable scales 0-500, 0-2000, 0-500, 0-10000, and 0-20000 michrohms).
    c. Modular hardware and software for easy access and service.
    d. Pre-wired NEMA 4X enclosure, 120 volt/1 phase/60 hertz power requirement
    e. Hi-Lo alarm indicator.
    f. Mounted flow assembly.
    g. Selectable chemical feed timer: "percent", "limit", or "pulse".
    h. 28-day dual biocide feed.
    i. Serial line with communications software.
    j. 4-20 mA isolated programmable proportional output for remote monitoring of system conductivity.

2.4 CHEMICALS FOR CLOSED SYSTEMS

A. The University will supply chemicals as used on campus for system start-up water treatment. Coordinate quantities required with the University's representative. Treatment will occur after piping has been cleaned and tested. If because of the contractor's error, additional chemicals are needed, the University will provide chemicals at contractor's cost.

B. Provide 48 hours notice when chemical treatment is needed. Piping system must have been tested and approved and completely cleaned and flushed prior to this request. Provide an appropriate chemical for cleaning piping system. Discharge is required to be indirectly into sanitary sewer. The University has no preference for pipe cleaning chemicals, except Trisodium Phosphate (TSP) shall not be used.

C. Provide automatic feed water conditioning equipment for steam boilers, hot water boiler systems, and steam and hotwater heating systems connected to HTW generators and converters. Include water conditioning of make up and feedwater to steam boilers and HTW steam generators.

D. Coupon racks are not required at buildings unless directed by the University.

E. Clean Steam Generators: As recommend by the chemical treatment company and for use with sterilizers, and food service. FDA approved for use on sterilization, food service (direct contact), and humidification.

PART 3 - .EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Place terminal control valves in open position during cleaning.

3.2 CLEANING SEQUENCE

A. Add cleaner to closed systems at concentration as recommended by manufacturer but not less than one pound per 100 gallons of water.

B. Use neutralizer agents on recommendation of system cleaner supplier.

C. Flush open systems with clean water for one-hour minimum. Drain completely and refill.

D. Remove, clean and replace strainer screens.

E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around globe valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION 23 2500

SECTION 23 3113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
3. Double-wall, round, and flat-oval spiral-seam ducts and formed fittings.
4. Duct liner. Use of fibrous glass duct liners shall be prohibited unless recommended by the sound consultant and approved by the University.

B. Related Sections include the following:

1. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct mounting access doors and panels, turning vanes, and flexible ducts.
2. Division 23 Section “Vibration and Seismic Controls for HVAC” for vibration isolation and seismic bracing requirements.
3. Division 23 Section “HVAC Insulation” for insulation and jacketing requirements.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

1. Duct system design shall be used to select size and type of air-moving and -distribution equipment and other air system components. Design of the layout and configuration of duct system shall be approved in writing by the University’s Representative.

B. Structural Performance: Refer to Section 23 0548 “Vibration and Seismic Controls for HVAC.”

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.3 SUBMITTALS

A. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1foot scale for the occupied floor plans. Mechanical rooms and rooftop plan shop drawings shall be ½” equals 1’-0” scale. Show fabrication and installation details for metal ducts.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Equipment service clearance and access panels and door swings.
3. Duct layout indicating sizes and pressure classes.
4. Elevations of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Duct accessories, including access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.
13. Fabrication details and materials may be a separate submittal from ductwork shop drawings.
14. Seismic bracing calculations, details, products, and plans.

B. Coordination Drawings: Refer to 01 for requirements of "Coordination Detailing Activity". Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required providing access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Welding certificates.

D. Field quality-control test reports.

E. LEED Submittals:

1. Product Data for LEED-NC Prerequisite EQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
2. Product Data for LEED-NC Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

3. Leakage Test Report for LEED-NC Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1-2004, Section 6.4.4.2.2 - "Duct Leakage Tests."

4. Duct-Cleaning Test Report for LEED-NC Prerequisite EQ 1: Documentation of work performed for compliance with ASHRAE 62.1-2004, Section 7.2.4 - "Ventilation System Start-Up."
5. Product Data for LEED-NC Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

F. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Mackups

a Mockup will be done in place and if approved will become part of the completed work.

C. Seismic Engineering: Seismic bracing and support design, product installation, equipment, and systems shall conform to the CBC requirements for Seismic Zone 4. Submit calculations, plans, and documents stamped by a qualified California registered engineer.

D. Structural Review: Seismic engineering submittal documents, seismic loads, anchorage loads, and all vertical loads applied to the building structure shall be approved by the project structural engineer of record.

E. ASHRAE and LEED-NC Prerequisite EQ 1 Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

F. ASHRAE/IESNA and LEED-NC Prerequisite EA 2 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation. Ducts shall have mill-phosphatized finish for surfaces exposed to public view and that are specified to be painted.

C. Stainless Steel: ASTM A 480/A 480M, Type 316L or 304. Minimum 20 gage. All welded construction.

D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

F. Tie Rods: Tie rods complying with SMACNA may be used on ductwork more than 52-inches wide

2.3 DUCT LINER

A. Fibrous-Glass Liner: Shall not be used without University’s Representatives written approval.

1. Manufacturers:

    a. Certain Teed Corp.; Insulation Group.
    b. Johns Manville International, Inc.
    c. Knauf Fiber Glass GmbH.
    d. Owens Corning.
    e. Or equal.

2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.

    a. Thickness: 1 inch.

b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke developed index of 50 when tested according to ASTM E 84.
d. Liner Adhesive: Comply with ASTM C 916.
e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

f. For indoor applications and to comply with LEED-NC Credit EQ 4.1, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Elastomeric Duct Liner: Comply with NFPA 90A. Shall not be used without University's Representatives written approval.

1. Manufacturers:

a. Armstrong World Industries, Inc.
b. Or equal.

2. Materials: Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density, for applications less than 220 Deg F.

a. Thickness: 1 inch.
b. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke developed index of 50 when tested according to ASTM C 411.
d. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A.
e. For indoor applications and to comply with LEED-NC Credit EQ 4.1, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches minimum.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications and to comply with LEED-NC Credit EQ 4.1, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications and to comply with LEED-NC Credit EQ 4.1, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, drilled in fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Concrete Inserts: Carbon steel, electro-galvanized, except exterior or corrosive environments shall be stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. UL listed for use in metal deck formed concrete and formed slabs for pre-positioning and attaching hanger rods in poured concrete decks. Suitable for seismic loads and brace attachments.

a. Manufacturers:

1) B-Line Systems, Inc.; a division of Cooper Industries.
2) ISAT (Blue Banger Hanger).
3) Simpson Strong-Tie Company (Blue Banger Hanger).
4) NIBCO Inc.; Tolco.
5) Or equal.

2. Use drilled in concrete fasteners for standard-weight aggregate concretes or for slabs more than 5 inches thick.
3. Shot pins may be installed using Ramset © gas driven fastening system. Do not use powder-actuated fasteners.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Galvanized-steel or stainless steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.6 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals except as modified by this specification.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Elbows shall be radius or short radius with vanes, type RE 1 and RE 3 in the SMACNA manual. Mitered elbows with turning vanes and other types shall not be used, use short radius elbows with vanes where space is limited. Construct vanes per pages A.41 and A.43 of the SMACNA manual.

C. Divided flow branches shall be per SMACNA manual figure 2-5, type 1 or type 4A or 4B only.

D. Branch connections per SMACNA manual figure 2-6; 45-degree entry shall only be used where airflow in branch is less than 25% of total airflow in main duct.

E. Offsets shall be SMACNA manual figure 2-7, type 3 only.

F. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Nexus Inc.
c. Ward Industries, Inc.
d. Or equal.

G. Longitudinal Seams: Pittsburgh lock sealed with non-curing polymer sealant. Button punch snap lock seams are not acceptable to the University and shall not be used.

H. Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations.

I. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359inch thick or less, with more than 10 sq. ft. of non-braced panel area unless ducts are lined.

2.7 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with at least 100 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams.

G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

1. Fan discharges.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

I. If duct velocities are greater than 4000 fpm, secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

1. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent. Use solid metal (non-perforated) inner ducts for material handling exhaust systems.

J. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches in diameter with butt-welded longitudinal seams.

1. Manufacturers:

a. McGill AirFlow Corporation.
b. SEMCO Incorporated.
c. Contractors Fabrication shop
d. Or equal.

D. Duct Joints:

2. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
3. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
4. Ducts Larger than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.

E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of dieformed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:

a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:

a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows 14 Inches and Less in Diameter: Adjustable elbows for 30, 45, 60, and 90 degrees only. After installation screw segments in place and seal all segment joints. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows14 Inches and above in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction. Fabricate 90 degrees elbows with minimum of 5 pieces.
8. Round Elbows Larger than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
10. Round Gored-Elbow or adjustable elbows Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

2.9 DOUBLE-WALL DUCT AND FITTING FABRICATION

A. Manufacturers:

1. Lindab Inc.
2. McGill AirFlow Corporation.
3. SEMCO Incorporated.
4. Or equal.

B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.

1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.

2. Insulation: 3-inch- thick fibrous glass. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.

    a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.

3. Solid Inner Ducts: Use the following sheet metal thicknesses and seam construction:

    a. Ducts 3 to 8 Inches in Diameter: 0.019 inch with standard spiral-seam construction.
    b. Ducts 9 to 42 Inches in Diameter: 0.019 inch with single-rib spiral-seam construction.
    c. Ducts 44 to 60 Inches in Diameter: 0.022 inch with single-rib spiral-seam construction.
    d. Ducts 62 to 88 Inches in Diameter: 0.034 inch with standard spiral-seam construction.

4. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inchdiameter perforations, with overall open area of 23 percent.
5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

C. Fittings (from minus 2- to plus 10-inch wg): Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.

1. Solid Inner Ducts: Use the following sheet metal thicknesses:

    a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
    b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
    c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.

2. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inchdiameter perforations, with overall open area of 23 percent.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless approved by the University's Representative, construct ducts according to the following:

1. Supply Ducts (exterior installation): 4-inch wg.
2. Supply Ducts before (upstream) Air Terminal Units (VAV boxes or air valves): 4-inch wg.
3. Supply Ducts after (downstream) Air Terminal Units (VAV boxes or air valves): 2-inch wg.

4. Supply Ducts (in Mechanical Equipment Rooms): 4-inch wg.
5. Return ducts (negative pressure) after (downstream) Air Terminal Units (VAV boxes, air valves, or filters): 2-inch wg.
6. Return Ducts (negative pressure) before (upstream) Air Terminal Units (VAV boxes, air valves, or filters): 2-inch wg.
7. General exhaust (negative pressure) after (downstream) Air Terminal Units (VAV boxes, air valves, or filters): 4-inch wg.
8. General Exhaust Ducts (negative pressure) before (upstream) Air Terminal Units (VAV boxes, air valves, or filters:): 2-inch wg
9. Laboratory or vivarium Exhaust Ducts (negative pressure): 4-inch wg.
10. Laboratory or vivarium Exhaust Ducts exterior on roof (negative pressure): 4-inch wg.
11. Vertical risers shall be constructed to a minimum of 4-inch wg, regardless of type.

B. All ducts shall be galvanized steel except as follows:

1. Dishwasher ducts, pot sink hood, cart wash hood, Sterilizers and glass wash steam hood should be as followed:
    a. Concealed: 1st 20ft 316L or 304 Stainless Steel or back to duct main connection.
    b. Exposed: 1st 20ft 316L or 304 Stainless Steel
    c. Weld and flange seams and joints.

2. Laboratory or vivarium (Fume-Handling) Ducts, exhaust (except biosafety cabinets): Type 316L, or 304 to main stainless-steel sheet, welded construction.
3. Vivarium Cage Washer and Rack Washer Exhaust Duct: Type 316L or 304, stainless-steel sheet, welded construction.
4. Shower exhaust duct: First 20 feet from register, Aluminum or 304
5. Duct mounted humidifier: Type 304 stainless steel, minimum of 8’-0” length, or 1.5 times the absorption distance, whichever is greater. Type 304 stainless steel.
6. Ductwork installed within 50 feet of cooling tower or similar evaporative device: Type 316L.
7. Ductwork exposed on roof: Galvanized Duct
8. Wet Process Exhaust: Type 304 stainless steel.
9. Outside Air / Air Make-up Ducts: Galvanized Duct

10. Floor trench with no access shall be Type 316L stainless with welded joints and flexible elastomeric insulation (not fiberglass).

C. Round ducts shall be used to the maximum extent possible. Rectangular ducts shall be limited to areas of space restriction with a maximum aspect ratio of 3:1. If due to a structural clearance constraint, duct aspect ratio can be increased and/or duct cross section reduced if upstream transition has included angles of 60 degrees or less and downstream transition has included angles of 30 degrees or less.

D. Ducts exposed outside to elements shall only be of round construction to shed rainwater. If conditions do not allow round ducts, provisions shall be provided to slope the flat top of rectangular ductwork so rainwater will not stand on top of duct.

E. Except for connection of terminal discharge duct to air outlets, 90 degree taps shall not be used. Takeoff feeding terminals shall be conical branch; 45 wye, conical branch; low loss tee; bell mouth, or branch with a loss coefficient equivalent to that for the conical branch. The slopes of transitions shall be approximately one to five, and no abrupt changes or offsets of any kind in the duct system shall be permitted.

F. Fume Hood Duct System

1. Hood collar connections shall be made with concentric transitions having minimum round duct dimensions as follows:

NOMINAL BENCH TYPE HOOD SIZE, FEET	MINIMUM ROUND DUCT SIZE, INCHES
4	10
5	12
6	12
8	14

2. Branch to main fittings shall be wye, 30 or 45-degree converging type where the increase in main occurs at the fitting. Ductwork shall take the straightest route to the roof, minimizing bends and horizontal runs. Increased distances and bends create resistance to airflow and require larger exhaust motors.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 10 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs in ducts that would be over 12 feet in length.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. If space permits, install ducts with a clearance of 2 inch on each side, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Stainless steel ducts connected to air valves and fume hoods shall be flanged.

M. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures and telephone equipment rooms.

N. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers or combination fire/smoke dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."

P. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by California building codes.

Q. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

R. Do not paint interiors of metal ducts except for air distribution metal cans as required.

S. Protect duct openings from damage and prevent entrance of foreign materials.

T. Sealants shall not take the place of welding of metal ducts, where required.

3.4 SEAM AND JOINT SEALING

A. Seal all duct seams and transverse and longitudinal joints regardless of pressure classification.

B. Seal ducts before external insulation is applied.

C. Provide airtight seal on seams around fan and coil housings.

D. Do not use permanent sealants on duct mounted equipment. Sealant at equipment, or other induct maintenance component, shall be sealed with a code approved sealant that may be easily removed and replaced upon repair and replacement of the device connected to the ductwork.

3.5 HANGING AND SUPPORTING

A. Attachment method, hanger device selection, loads, and spacing shall be coordinated and approved with the structural engineer.

B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts at maximum intervals of 16 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load. Wire and friction clamps shall not be used.

E. Install concrete inserts before placing concrete.

F. Install drilled in concrete anchors after concrete is placed and completely cured.

G. Do not use powder-actuated concrete fasteners. Gas driven fasteners may be used.

H. Wet, or High Moisture Areas: Provide stainless steel supports, brackets, and mounting hardware for spaces that have wet process, wash-down, or high humidity.

I. Outdoor Applications: All outdoor support assemblies shall be of “stainless steel material”, or “hot-dip galvanized carbon steel.

1. Stainless steel: Mounting hardware such as bolts, nuts, washers, straps, brackets, fastening hardware etc., shall be stainless steel.
2. Coated galvanized steel: Carbon steel support assemblies, including all metal fabrications for use outdoors shall comply with each paragraph listed below:

    a. Assemblies must be shop-fabricated and hot-dip galvanized coating process
    b. Touch-up and repair per manufacturer’s recommendations after field installation.

J. Ducts and equipment shall be supported high enough above roofing surfaces to allow roofing access for maintenance and repair. Install ducts and equipment at a minimum height as shown in Table 4-1 of SMACNA Architectural Sheet Metal Manual – 5th Edition.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories" unless equipment is internally isolated.

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

C. Make connections to grilles, registers or diffusers the same size as the flange outer perimeter or neck size of the grille, register, or diffuser.

3.7 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

B. Supply, return and exhaust ducts shall be sealed to minimize leakage. Ducts in concealed spaces such as chases or shafts and above wallboard ceilings shall be pressure-tested prior to concealment. Seams and joints of ducts shall be sealed with mastic or mastic plus tape or gasketing as appropriate to limit the air leakage.

C. Laboratory exhaust shall not have any leakage. Pressure test at 95% of duct pressure rating, checking every joint by spraying with bubbles to verify seal.

D. Materials such as duct, stiffeners, gaskets, bolting, etc., intended as part of the final installation, which are damaged during testing shall be replaced.

E. Ductwork may be tested in sections. The section of the ductwork to be tested shall be prepared by blanking off duct outlets, etc.

F. Dampers in the tested ductwork shall be left in the open position. Testing shall be satisfactorily completed before insulation or enclosure of the ductwork and before terminal units are installed.

G. Ductwork downstream of terminal units and air valves need not be leak tested.

3.8 CLEANING NEW SYSTEMS

A. SMACNA Intermediate Cleanliness level shall be followed as outlined in "SMACNA Duct Cleanliness for New Construction Guidelines". If the ductwork system is maintained in a clean state during the installation the following is not required. If in the opinion of the University's Representative the ductwork system becomes dirty during installation the following shall be complied with:

B. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

C. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

D. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

E. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

G. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION 23 3113

SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Combination fire and smoke dampers.
7. Duct silencers.
8. Duct-mounting access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

B. Related Sections include the following:

1. Division 28 Section "Digital Addressable Fire Alarm System" for duct-mounted fire and smoke detectors.
2. Division 23 Section "Instrumentation and Controls" for electric and pneumatic damper actuators.
3. Division 23 Section “Custom Air-Handling Units.”
4. Division 23 Section “Metal Ducts.”

1.2 SUBMITTALS

A. Product Data: For the duct accessories to be used on this project.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Special fittings.
2. Manual-volume damper installations.
3. Motorized-control damper installations.
4. Fire-damper, smoke-damper, and combination fire and smoke-damper installations, including sleeves and duct-mounting access doors.
5. Wiring Diagrams: Power, signal, and control wiring.

C. Submittal shall include published leakage, pressure drop and maximum pressure data for a full range of damper sizes based on AMCA Standard 500 testing. Data from one size sample test is not acceptable.

D. LEED Submittal:

1. Product data: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 – “Systems and Equipment.”

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

C. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181.

D. Fire, Smoke, and Combination Fire-Smoke dampers shall conform to the California State Fire Marshall Listing for Fire Damper and Smoke Damper.

E. Fire dampers shall be listed by Underwriters Laboratories, Inc., complying with UL 555, Smoke, and Combination Fire-Smoke dampers shall be listed by Underwriters Laboratories, Inc., complying with UL 555S.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; exposed ducts shall have mill-phosphatized finish for paint adhesion.

C. Stainless Steel: ASTM A 480/A 480M, type 304, and having a No. 2 finish for concealed ducts and exposed ducts.

D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods, for ducts 52-inches or more in width: Galvanized steel, or stainless steel, 3/8-inch minimum diameter.

2.3 BACKDRAFT DAMPERS

A. Manufacturers:

1. Duro Dyne Inc.
2. Greenheck Fan Corporation.
3. Pottorff; a division of PCI Industries, Inc.
4. Ruskin Company.
5. Or equal

B. Description: Multiple-blade, parallel action gravity balanced, factory fabricated with center pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure. The damper shall be limited to 500 fpm velocity.

C. Frame: 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.

D. Blades: 0.025-inch- thick, roll-formed aluminum.

E. Blade Seals: Neoprene.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

I. Outside-Air: For outside air applications, provide stainless steel frame, axle, hardware, and damper blades.

2.4 VOLUME DAMPERS

A. Manufacturers:

1. McGill AirFlow LLC.

2. Pottorff; a division of PCI Industries, Inc.
3. Ruskin Company.
4. Contractor Fabricator per SMACNA Duct Construction Standards
5. Or equal.

B. General Description: Factory and shop fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

C. Standard Volume Dampers: Multiple-opposed-blade design, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications. Single blade design may be Contractor shop-fabricated per SMACNA guidelines.

1. Steel Frames: Hat-shaped, galvanized (provide stainless in outside air system) sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized (provide stainless in outside air system) sheet steel.
3. Blade Axles: Galvanized steel, or stainless steel.
4. Bearings: Oil impregnated bronze sleeve, or stainless-steel sleeve.
5. Tie Bars and Brackets: not allowed.

D. Low-Leakage Volume Dampers for fume hoods and similar installations: Multiple- or single blade, parallel- or opposed-blade design low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: stainless sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, stainless sheet steel.
3. Blade Axles: Stainless steel.
4. Bearings: Stainless-steel sleeve thrust or ball.
5. Blade Seals: Neoprene.
6. Jamb Seals: Cambered stainless steel.

E. Jackshaft: ½ -inch minimum- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 MOTORIZED CONTROL DAMPERS

A. Manufacturers:

1. Greenheck Fan Corporation.
2. McGill AirFlow LLC.
3. Nailor Industries Inc.
4. Ruskin Company.
5. Or equal.

B. General Duty Control Dampers: AMCA-rated, opposed-blade design, double-skin air foil shape; minimum of 0.1084-inch- thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch- thick, galvanized-steel damper blades with maximum blade width of 8 inches and stainless steel jamb seals.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with externally mounted regreaseable stainless steel ball type bearings (Oil impregnated bronze, stainless sleeve or synthetic bearings are not acceptable), out of airstream blade linkage hardware of zinc-plated steel and brass, end seals, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Provide opposed-blade design with inflatable seal blade edging, or replaceable EPDM blade seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.
4. Maximum pressure drop shall be 0.07 inches WG for a 24-inch by 24-inch duct-mounted damper handling 8,000 cfm.
5. Outside-Air/Relief-Air: For outside air applications, provide stainless steel frame, axle, hardware, and damper blades.

2.7 SMOKE, OR COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Greenheck.
2. Pottorff.
3. Ruskin Company.
4. Or equal.

B. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

C. Fusible Links: Replaceable, 165 deg F. or, and 212 deg F. rated as applicable.

D. Frame and Blades: 0.064-inch- thick, galvanized sheet steel, or stainless steel.

E. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

F. Damper Motors: Provide for modulating or two-position action.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
3. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
4. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
5. Electrical Connection: 115 V, single phase, 60 Hz.

G. Access doors shall be provided for the dampers.

H. Dampers shall be duct size or sized to limit loss coefficient to 0.05" w.g., whichever is greater. Small ducts may need to be increased in size to limit pressure loss.

I. Multi-leaf dampers shall have airfoil blades. Damper design shall have maximum pressure drop of 007 inches w.g. corresponding to a 24-inch by 24-inch damper handling 8,000 cfm.

J. Dampers shall bear the UL and CSFM listed labels.

2.8 DUCT SILENCERS

A. Manufacturers:

1. Metal Form Manufacturing Inc.; Commercial Acoustics.
2. Industrial Noise Control, Inc.
3. McGill AirFlow LLC.
4. Ruskin Company.
5. Vibro-Acoustics.
6. Or equal

B. General Description: Factory-fabricated and -tested, round or rectangular silencers with performance characteristics and physical requirements as indicated.

C. Fire Performance: Adhesives, sealants, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame-spread index and 50 for smoke-developed index when tested according to ASTM E 84.

D. Rectangular Units: Fabricate casings with a minimum of 0.034-inch- thick, solid galvanized sheet metal for outer casing and 0.022-inch- thick, ASTM A 653/A 653M, G90, perforated galvanized sheet metal for inner casing. Attenuators in 100% outside air or fume hood exhaust system shall have a solid stainless steel internal lining.

E. Round Units:

1. Outer Casings:

    a. ASTM A 653/A 653M, G90, galvanized sheet steel.
    b. Up to 24 Inches in Diameter: 0.034 inch thick.
    c. 26 through 40 Inches in Diameter: 0.040 inch thick.
    d. 42 through 52 Inches in Diameter: 0.052 inch thick.
    e. 54 through 60 Inches in Diameter: 0.064 inch thick.
    f. Casings fabricated of spiral lock-seam duct may be one size thinner than that indicated.

2. Interior Casing, Partitions, and Baffles:

    a. ASTM A 653/A 653M, G90, galvanized sheet steel.
    b. At least 0.034 inch thick and designed for minimum aerodynamic losses.
    c. Attenuators in 100% outside air or fume exhaust system shall have a solid stainless steel internal lining.

F. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

G. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.

1. Erosion Barrier: Polymer bag enclosing fill and heat-sealed before assembly.

H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.

1. Do not use nuts, bolts, or sheet metal screws for unit assemblies.
2. Lock form and seal or continuously weld joints.
3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
4. Reinforcement: Cross or trapeze angles for rigid suspension.

I. Source Quality Control:

1. Acoustic Performance: Test according to ASTM E 477.
2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.
3. Leak Test: Test units for air tightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.9 TURNING VANES

A. Not to be used. Provide short radius elbows with vanes per SMACNA details in appendix.

2.10 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class. Include vision panel where indicated.

B. Access Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal, or stainless steel, with insulation fill and thickness as indicated for duct pressure class. Include piano hinge and cam latches.

1. Manufacturers:

    a. Ductmate Industries, Inc.
    b. Flexmaster U.S.A., Inc.
    c. Greenheck Fan Corporation.
    d. McGill AirFlow LLC.
    e. Pottorff; a division of PCI Industries, Inc.
    f. Ruskin Company.
    g. Or equal.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Hinges: Continuous piano hinges.
4. Low Pressure Rating: Low pressure applications, rated between negative 2-inches and positive 2-inches static pressure.

C. Access Door: Double wall, duct mounting, for round or rectangular ducts; fabricated of galvanized sheet metal, or stainless steel, with insulation fill and 1-inch thickness, closed cell neoprene gasket, closure knobs with zinc plated springs and bolts. Provide accessory safety chain.

1. Manufacturers:

    a. Ductmate Industries, Inc.
    b. Flexmaster U.S.A., Inc.
    c. Greenheck Fan Corporation.
    d. Pottorff; a division of PCI Industries, Inc.
    e. Ruskin Company.
    f. Or equal.

2. Frame: None. Sandwich type configuration with outer door galvanized sheet steel. notched frame.
3. Hinge: None.
4. Gasket location: shall be interchangeable for positive and negative pressure applications, per manufacturer's guidelines.
5. Pressure Rating: Ultra low leakage for positive or negative 8-inch w.c.

D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal, or stainless steel, with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.

1. Manufacturers:

    a. Ductmate Industries, Inc.

b. Greenheck Fan Corporation.
c. Ruskin Company.
d. Or equal.

2. Frame: Galvanized sheet steel, with bend-over tabs and neoprene gaskets.
3. Provide negative pressure and positive pressure relief doors design to open automatically to prevent exploding or imploding ductwork in the event dampers close or some other event may occur while the fan is still operating. The door shall automatically close and reset when the pressure is equalized or the system shuts down. Ruskin models PRD18, NRD18 or ADHP-3. Provide insulated doors in supply air systems, stainless steel construction for hazardous air exhaust systems and construction shall be appropriate for the pressure class.
4. Seal around frame attachment to duct and door to frame with neoprene rubber.
5. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Duro Dyne Inc.
2. Ventfabrics, Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Or equal.

B. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

C. Indoor System, Flexible Connector Fabric: Woven nylon and polyester blend with binyl coating.

1. Minimum Weight: 22 oz./sq. yd.
2. Tensile Strength: 240 lbf/in wrap and 220 lbf/in filling.
3. Service Temperature: -40 to 180 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric insulated double coated with weatherproof, Hypalon synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 23 oz./sq. yd.
2. Insulation: Fiberglass.
3. Tensile Strength: 225lbf/in wrap.
4. Service Temperature: Zero to plus 240 deg F.

F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 200 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Zero to plus 500 deg F.

G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with Teflon chemicalresistant coating including gasoline grease and acetone, UL 214 listed.

1. Minimum Weight: 14 oz./sq. yd..
2. Pressure Rating: 8-inch wg positive and 5-inch wg negative.
3. Tensile Strength: 300 lbf/inch in the warp and 275 lbf/inch in the filling.
4. Service Temperature: Zero to plus 500 deg F.

2.12 DRAWBAND CONNECTORS

A. Manufacturers:

1. Phoenix Controls Corp.
2. Flexmaster U.S.A., Inc.
3. Or equal.

B. General Description: Formed galvanized steel cylindrical sleeve with internal gasket and external drawband bolts. Flame-retardant or noncombustible gaskets and adhesives complying with UL 181, Class 1.

1. Pressure Rating: 10-inch wg positive and 5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 200 deg F.
4. Fume Hood or Corrosive Application: Chemically resistant gasket material. Galvanized metal shall not contact airstream.

2.13 FLEXIBLE DUCTS

A. Manufacturers:
1. Buckley Associates, Inc.
2. CASCO; Cal-Flex
3. Flexmaster U.S.A., Inc.
4. Quietflex Manufacturing Co.
5. Or equal.

B. Non-insulated, Non-Metallic Flexible Duct: UL 181, Class 1, black polymer reinforced sheeting or coated fiberglass cloth fabric supported by helically wound, spring-steel wire.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.

C. Non-insulated, Non-Metallic Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil, or coated heavy fiberglass cloth fabric.

1. Pressure Rating: 8-inch wg positive and 5.0-inch wg negative.
2. Maximum Air Velocity: 5000 fpm.
3. Temperature Range: Minus 100 to plus 435 deg F.

D. Insulated, Non-Metallic Flexible Duct: UL 181, Class 1, black polymer film or coated fiberglass cloth fabric supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene fire retardant vapor-barrier film.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Minimum Installed R-Value: R-4.2
4. Temperature Range: Minus 20 to plus 175 deg F.

E. Insulated, Non-Metallic Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil or coated fiberglass cloth fabric; fibrous-glass insulation; polyethylene fire retardant vapor-barrier film.

1. Pressure Rating: 8-inch wg positive and 5.0-inch wg negative.
2. Maximum Air Velocity: 5000 fpm.
3. Minimum Installed R-Value: R-4.2
4. Temperature Range: Minus 20 to plus 250 deg F.

F. Flexible Duct Connectors:

1. Clamps: Stainless-steel band clamps with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Sheet Metal Screws: For flexible duct connectors with metal collars, use minimum (3) sheet metal screws and duct sealer.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

B. Provide duct accessories and components of materials suited to duct materials; use galvanized steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers on general low volume (less than 2,500 cfm) exhaust fans or exhaust ducts nearest to outside.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing volume dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff. Provide exterior insulated ducts with 12” long flags hanging from damper handle for locating dampers.

F. Provide instrument test holes in ductwork at fan inlets and outlets and elsewhere as required by Testing, Adjusting and Balancing contractor for testing and balancing purposes. Factory install test holes for air handling units.

G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.

H. When approved by the University's representative in writing, install duct silencers rigidly to ducts and provide supports.

I. Install duct access doors suitably sized and locate so as to allow for safe inspecting, testing, adjusting, and maintaining accessories and terminal units as approved by University Representatives and as follows:

1. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
2. To interior of ducts for cleaning; at base of risers or bottom of multi-story drops.
3. On sides of ducts where adequate clearance is available.

J. Install the following minimum sizes for rectangular duct-mounting, rectangular access doors:

1. 8 by 5 inches for 6-inch duct size and smaller.
2. 12 by 6 inches for 8-inch to 10-inch duct sizes.
3. 12 by 8 inches for 11 to 13 duct sizes.
4. 12 by 12 inches for 14-inch to 24-inch duct sizes by maximum of 18-inches wide.
5. 20 by 12 inches for 14-inch to 24-inch duct sizes by 19" and wider.
6. 24 by 24 inches for larger duct sizes than listed above.

K. Install the following minimum sizes for round duct-mounting, round access doors:

1. 8 inches in diameter for up to 12-inch diameter duct size.
2. 12 inches in diameter for 13-inch to 19 inch duct sizes.
3. 18 inches in diameter for 20-inch to 25 inch duct sizes.
4. 24 inches in diameter for larger duct sizes than listed above.

L. Label access doors according to Division 23 Section "Identification for HVAC."

M. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

N. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. For air systems with fire or smoke dampers in the mains provide pressure relief dampers when fan static exceeds pressure class of ductwork.

P. Connect terminal units to supply ducts directly.

Q. Connect diffusers, registers and grilles with lengths of flexible duct clamped or strapped in place without kinks and not exceeding an angular layout sum of 135 degrees. Do not use flexible ductwork above hard lid gypsum or similar inaccessible ceilings. Do not use flexible ducts to change directions more than 135 degrees, with 90 degrees the turn down from horizontal duct to diffuser, register or grille in ceiling.

R. Connect flexible ducts to metal ducts with adhesive and band clamps. Flexible ducts with galvanized sheet metal collars shall be connected with duct sealant and sheet metal screws. S.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed. Location and operation of access doors shall be witnessed and approved by Campus Fire Marshal prior to concealment.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed. Test shall be witnessed by Campus Fire Marshal prior to concealment.
4. Operate remote damper operators to verify full range of movement of operator and damper.

B. Adjusting:

1. Adjust duct accessories for proper settings.
2. Adjust fire and smoke dampers for proper action.
3. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing,
Adjusting, and Balancing for HVAC."

END OF SECTION 23 3300

SECTION 23 3400 – FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Utility set fans.
2. Centrifugal roof ventilators.
3. Vaneaxial fans.
4. Upblast propeller roof exhaust fans.
5. Ceiling-mounting ventilators.
6. High-Plume Dilution Laboratory Exhaust Fans
7. Mixed Flow Fans
8. Manufacturer’s Roof Curbs

B. Related Sections include the following:

1. Division 23 Section “Common Motor Requirements for HVAC equipment”.
2. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”.
3. Division 23 Section "Seismic Restraint for HVAC".
4. Division 23 Section “Vibration Controls for HVAC”.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level unless otherwise indicated.

B. Operating Limits: Classify according to AMCA 99.

C. Wind Loads: Exterior fans, curb mounting assemblies and attachment to structure shall meet the wind structural loading requirements of the local Building Codes and Authorities Having Jurisdiction.

1. Wind Design Pressures: As determined from wind speed, building category, wind exposure indicated on the structural drawings for specific equipment location calculated per the structural wind loading requirements of the Building Code.
2. Structural Attachment Forces: As determined from wind design pressures using actual equipment dimensions calculated per the structural wind loading requirements of the Building Code.

D. Wind and Impact Loads: Exterior fans, curb mounting assemblies and attachments to structure shall meet the wind and impact structural loading requirements of the Florida Building Code and Authorities Having Jurisdiction. Provide fans and assemblies with current wind and impact certification by Florida Product Approval, Miami-Dade "Notice of Acceptance" (NOA) Product Approval or other approved testing agency.

1. Wind Design Pressures: As determined from wind speed, building category, wind exposure indicated on the structural drawings for specific equipment location calculated per the structural wind loading requirements of the Building Code.
2. Structural Attachment Forces: As determined from wind design pressures using actual equipment dimensions calculated per the structural wind loading requirements of the Building Code.
3. Windborne-Debris-Impact-Resistance-Test Performance: Provide equipment that pass large and small missile-impact tests and cyclic-pressure tests according to Section 1626 of the Florida Building Code.

E. Seismic: Fans and curb mounting assemblies shall withstand the effects of seismic forces in accordance with project Seismic specifications.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, furnished specialties, dimensions, weights and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated. Fan curves shall include a series of curves indicating the relationship of CFM and static pressure for various RPM. Brake horsepower curves shall also be included. Indicate the design operating point clearly on the fan curves. Indicate fan brake horsepower requirement at the design operating point.
3. Certified octave band fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Dampers, including housings, linkages, and operators.
7. Diagrams for power, signal, and control wiring

1.5 INFORMATIONAL SUBMITTALS

A. Wind compliance: Contractor's certification of compliance with wind structural loading requirements of the Building Code, wind loads identified in "Performance Requirement" article and Authority Having Jurisdiction. Submit as applicable:

1. Product Approval: Equipment specific documentation indicating compliance.
2. Delegated Design: Signed and sealed documents by registered engineer.
3. Dimensioned Outline Drawings of Equipment: Identify maximum rated wind force in pounds per square foot, mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Wind and Impact Additional Qualifications: Manufacturer's certification that equipment will withstand both wind and impact loads identified in "Performance Requirement" Article.

C. Seismic Qualification: Manufacturer's certification of seismic qualification according to ASCE 7. Submit ASCE 7 special seismic certification as required. Include method used to determine compliance with requirements.

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: One extra set for each belt-driven unit.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members and concrete bases where applicable.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations, where applicable.

1.10 DESIGN CRITERIA

A. All fans shall be tested as complete units in accordance with the applicable test code of AMCA and shall be certified by AMCA.

B. All fans with belt drives shall be provided with variable pitch V-belt sheaves for purpose of system balancing. After system is balanced, fixed pitch sheaves shall replace the variable pitch sheaves for all motors using multiple belt drives.

C. Each fan and motor combination shall be capable of meeting the following conditions while maintaining stable fan performance: deliver plus or minus 10% of the air quantity scheduled at the scheduled static pressure; deliver the air quantity scheduled at 125% of the scheduled static pressure. Provide Class I, II or III fan construction as required. The motor furnished with the fan shall not operate into the motor service factor in any of these cases. Drive efficiency shall be considered in motor selection according to manufacturer's published recommendations, or according to AMCA.

D. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, Contractor shall submit a scaled layout of the change and system effect factor calculations, indicating increased static pressure requirements as described in AMCA. This Contractor shall be responsible for any motor, drive and/or wiring changes required as a result of duct configuration changes at fan.

E. Where fan drives are exposed use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation. Provisions shall be made so that tachometer may be used to verify fan speed without removing the guard assembly.

F. All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.

G. Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

H. Fan size, fan class, wheel type, inlet type, capacity, arrangement operating characteristics and any other special requirements shall be as indicated on the plans and/or as scheduled.

I. All fans serving a “fume” application (i.e., fume hoods) shall be completely coated internally with a baked phenolic coating, minimum 4 mils thick.

J. Fan bearings shall be heavy duty grease lubricated, ball or roller type selected for a Basic Rating Life (L_{10}) of at least 80,000 hours unless otherwise indicated in the fan product section. All bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extended to the motor side of the fan.

K. All belt-driven drive assemblies shall be factory mounted, with final alignment and belt adjustment made after installation. Fan shafts shall be turned, ground and polished steel and keyed to wheel hub. Fan Pulleys shall be Cast iron with split, tapered bushing and dynamically balanced at factory. Motor Pulleys shall be adjustable pitch. Select motor pulley so pitch adjustment is at the middle of adjustment range at fan design conditions. Belts shall be oil resistant, nonsparking, and nonstatic with matched sets for multiple belt drives. Motor mounts shall have an adjustable base. Fan and motor shall be isolated from the exhaust air stream unless otherwise indicated.

L. All V-belt drives shall be designed for 150% of motor rating.

M. For direct drive fans with VFDs and bypass starter, select fan to operate at or above the fan's motor speed to allow fan operation in bypass mode.

N. Provide stainless steel fasteners to secure fan to curb.

O. Provide electrically commutated motors (ECM) for all direct drive fans with single phase motors.

P. Provide backdraft or motorized dampers for fans where required by the plans and/or schedules. Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve or roof curb; factory set to close when fan stops. Motorized dampers shall be parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

Q. Exhaust fans and attachments to structure shall be designed to conform with the wind and seismic structural loading requirements identified in "Performance Requirement".

R. Forward curved fans may be provided when scheduled and when static pressure differential at fan is 1.5" W.G. or less.

S. Elevated Temperature Rating: Exhaust fans part of smoke control systems shall be UL listed as "Power Ventilators for Smoke Control Systems" for operational temperatures as approved by the AHJ for 500 F maximum temperature for a minimum of 4 hours or operation.

PART 2 - PRODUCTS

2.1 UTILITY SET FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation
2. Loren Cook Company
3. Peerless
4. Twin City Fan

B. Description: Single-width, single inlet direct- or belt-driven centrifugal fans consisting of rotatable housing, wheel, fan shaft, bearings, motor, starter and disconnect switch, drive assembly, and accessories. [Comply with wind and impact load Performance Requirements for exterior fans.]

C. Housing: Fabricated of steel coated with electrostatically applied baked polyester urethane with side sheets fastened with air tight lock formed seams or welded to scroll sheets with inlet cone. Belt guards or weather hood for exterior applications.

1. Housing Discharge Arrangement: Adjustable to eight standard positions.

D. Fan Wheels: Single-width, single inlet non overloading aluminum or steel air foil or backward inclined blades secured to backplate.

E. Accessories:

1. Inlet and Outlet: Flanged.
2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
3. Access Door: Gasketed door in scroll with latch-type handles.
4. Inlet Screens: Where applicable provide removable wire mesh.
5. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
6. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment for exterior applications.
7. Dampers: Counterbalanced or motor operated as scheduled, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stop.

F. Coatings: Epoxy

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation
2. Loren Cook Company
3. Twin City Fan

B. Description: Roof mounted direct- or belt-driven centrifugal fans with motor out of air stream consisting of housing, wheel, fan shaft, bearings, motor, starter and disconnect switch, drive assembly, curb cap, and accessories. [Comply with wind and impact load Performance Requirements for exterior fans.]

C. Housing: Aluminum along with curb cap, windband and ventilated motor compartment with removable housing. Curb cap with integral venturi inlet cone.

1. Upblast Units: If listed on the plans, provide design of wind band to direct discharge air upward, with rain and snow drains and welded curb cap for waterproof construction.
2. Wireways: Integral internal wiring conduits for all power and control wiring for fan and curb.
3. Bird Screens: Where applicable provide removable, 1/2-inch mesh, aluminum or brass wire.
4. Vibration Isolation: factory installed vibration isolators for drive assembly.

D. Fan Wheels: Aluminum hub and wheel with non-overloading backward-inclined blades.

E. Accessories:

1. Dampers: Counterbalanced or motor operated as scheduled, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
2. Direct Drive Speed Controller

F. Roof Curbs: Straight sided curb of heavy gauge galvanized steel; mitered and welded corners with 4” minimum bottom flange, structural curb for positive attachment of fan to structure; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; curb seal. Size as required to suit roof opening and fan base.

1. Coordinate curb height with roof insulation thickness, and with other criteria such as snow. Minimum curb height is 18" to provide a minimum of eight (8) inches above finished roof.
2. Pitch Mounting: Manufacture curb for roof slope.
3. Damper holding tray: For fans scheduled with dampers.

2.3 VANEAXIAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation
   2. Loren Cook Company
   3. Twin City Fan

B. Description: Direct or belt drive, vaneaxial fan wheel and housing, straightening vane section**,** fan shaft, bearings, motor, starter and disconnect switch, drive assembly, , an inlet cone section, and accessories.

   1. Variable-Pitch Fans: Internally mounted electronic actuator, externally mounted positive positioner, and mechanical-blade-pitch indicator.

C. Housings: Fabricated of steel coated with electrostatically applied baked polyester urethene.

   1. Inlet and Outlet Connections: Flanges.
   2. Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.

D. Fan wheel Assemblies: Aluminum air foil blades adjustable pitch with in cast aluminum hub.

E. Accessories:

   1. Companion Flanges: Rolled flanges of same material as housing.
   2. Inspection Door: Bolted door allowing limited access to internal parts of fan, of same material as housing.
   3. Propeller Access Section Door: Short duct section bolted to fan inlet and/or outlet allowing access to internal parts of fan for inspection and cleaning, of same material as housing.
   4. Mounting Clips: Horizontal or Vertical mounting clips welded to fan housing, of same material as housing.
   5. Horizontal Support: Pair of supports bolted to fan housing, of same material as housing.
   6. Vertical Support: Short duct section with welded brackets bolted to fan housing, of same material as housing.
   7. Inlet and Outlet Screens: Wire-mesh screen on fans not connected to ductwork of same material as housing.
   8. Inlet Bell: Curved inlet for when fan is not attached to duct, of same material as housing.
   9. Inlet Cones: Round-to-round transition of same material as housing.
   10. Outlet Cones: Round-to-round transition of same material as housing.

F. Factory Finishes:

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.4 UPBLAST PROPELLER ROOF EXHAUST FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation
   2. Loren Cook Company
   3. Twin City Fan

B. Description: Direct- or belt-driven propeller fans consisting of housing, wheel, butterfly-type discharge damper, fan shaft, bearings, motor, starter and disconnect switch, drive assembly, curb cap, and accessories. Comply with wind and impact load Performance Requirements for exterior fans.

C. Housing: Reinforced and braced galvanized steel or aluminum, containing butterfly dampers, wind band, curb cap and rain trough:

   1. Wireways: Integral internal wiring conduits for all power and control wiring for fan and curb.
   2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   3. Vibration Isolation: factory installed vibration isolators for drive assembly.
   4. Damper Rods: Steel with bronze or nylon bearings.
   5. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheel: Replaceable, -aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

E. Accessories:

   1. Dampers: Counterbalanced or motor operated as scheduled, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
   2. Direct Drive Speed Controller.

F. Roof Curbs: Straight sided curb of heavy gauge galvanized steel; mitered and welded corners with 4” minimum bottom flange, structural curb for positive attachment of fan to structure; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; curb seal. Size as required to suit roof opening and fan base.

   1. Coordinate curb height with roof insulation thickness, and with other criteria such as snow. Minimum curb height is 18” to provide a minimum of eight (8) inches above finished roof.
   2. Pitch Mounting: Manufacture curb for roof slope.
   3. Damper holding tray: For fans scheduled with dampers.

G. Stack Cap: Vertical discharge assembly with backdraft dampers, of same material as housing.

2.5 CEILING-MOUNTING VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation
   2. Loren Cook Company
   3. Twin City Fan

B. Description: Centrifugal direct drive or belt drive fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, galvanized or aluminum.

D. Fan Wheel: Backward inclined aluminum wheel. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Plastic or Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:

   1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
   2. Isolation: Rubber-in-shear vibration isolators.
   3. Manufacturer's standard roof jack or wall cap, and transition fittings.
   4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in fan discharge; factory set to close when fan stops.

2.6 HIGH-PLUME DILUTION LABORATORY EXHAUST FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Strobic Air Tri-Stack or comparable product by one of the following:

   1. Greenheck Vektor MD
   2. M.K. Plastics

B. Description: Laboratory or industrial process fume exhaust system, producing a high discharge plume through inducing airflow at the fan outlet. Multiple fans may be configured with a common plenum, and bypass control dampers to maintain internal variable volume air flow, and constant volume exhaust. [Comply with wind and impact load Performance Requirements for exterior fans.]

C. Fan Housing: Housing and guide vane section shall be a minimum of 10 gauge hot rolled steel. The roof base shall be 7 gauge. The 7 gauge guide vane section shall be designed to straighten leaving air and direct it into twin, high velocity, discharge nozzles

D. Discharge Nozzles:

1. Nozzles shall be manufactured of chemical resistant fiberglass or steel having coatings equal to fan to reduce roof line mass and prevent caustic erosion. The nozzles shall be suitable for outlet velocities 4,000 to 7,000 FPM without vibration and shall be engineered to provide a passive third central stack over the motor with entrainment capabilities.

E. Radial Entrainment Windband: Windband shall be located at the discharge to prevent cross flow contamination and to improve overall entrained performance by volume up to 270% of design flow

F. Fan Wheels: The fan wheel shall be a radial mixed flow or backward-curved airfoil blade centrifugal configuration manufactured of welded steel. Radial mixed flow fan wheels shall be part backward curve centrifugal to avoid axial stall characteristics, and part axial to minimize mass and provide straight through flow. The mixed flow wheel shall be capable of handling system effects without stall. Direct-driven fans' balance shall not exceed 0.5 mil, peak to peak at the roof line.

G. Fan Isolation Dampers: Provide each fan with a motorized fan isolation control damper.

1. Dampers & Damper Operators: Two-position (Open-Close), airfoil type opposed blade (OBD), automatic control damper(s) of aluminum 6" w.c. service, with polyurethane edge seals, stainless steel bearings or silicone.
2. Electronic Damper Operators: Dampers are to open when the fan is energized and close via spring return when de-energized.
3. Damper operators shall be mounted outside of the exhaust air stream and protected from the weather.

H. Fan(s) Plenum: Provide a bypass (mixing = outdoor air +system air) plenum for the fans, where indicated on drawings. The plenum shall have a hinged and gasketed steel access door(s) and outside air bypass inlet(s) with airfoil type opposed blade, automatic control damper(s), electronic damper operator(s) and rain hood(s) with galvanized steel birdscreen.

1. Construction: Continuously welded, heavy gauge steel for single fans; double-wall, continuously welded heavy gauge steel with structural stiffeners for multiple-fans.
2. Exterior finish as specified herein. Interior finish to match that of the fan itself.
3. Primary Air Inlets: Bottom or side inlets as shown on drawings. Openings sized for air velocity less than or equal to 1,500 FPM.
4. Outside Air Bypass Damper(s): Modulating automatic control damper(s) of aluminum construction to 6" w.c. service, with polyurethane edge seals, stainless steel bearings and electronic damper operator(s). Damper operators shall be mounted outside of the outside air stream and protected from the weather.

I. Vibration: Each fan shall be vibration tested before shipping. Each fan shall be test run at the factory at the specified fan RPM, and vibration signatures shall be taken. The maximum allowable fan vibration shall be less than 0.10 in./sec. peak velocity.

J. Accessories:
1. Disconnect Switches: Furnish NEMA 3R non-fused disconnect switch, factory-mounted and wired.

2. Jib Crane Pedestal (Direct-Driven Top Plenum-Mounted Fans only): Provide a pedestal for a portable jib crane, one for every two fans, for motor removal. Weld pedestal to the fan's base on the plenum roof.
3. Lifting lugs of 0.25 inch plate minimum shall be provided for fans 5.0 horsepower and above.
4. Provide an aluminum fan inlet bell to prevent sparking should bearing failure occur.
5. Corrosion-Resistant Finish: Coat all parts of the fan in contact with the moving air stream.
6. All threaded devices in the airstream and exposed to outside air shall be a combination of Monel and 316 stainless steel to prevent seizure, erosion and/or embrittlement.
7. All non-welded joints and seams shall be gasketed with PTFE for air leakage tightness under maximum fan design operating pressure.
8. A drain system shall be provided, out of the airstream, to eliminate the possibility of duct contamination.
9. When fan(s) ship(s) separately from the plenum, all wiring and conduit shall be factory-supplied for field connection.
10. Finish dampers in a corrosion-resistant finish to match that of the fan.
11. Fan Access Door: A bolted and gasketed access door shall be provided in the fan shroud for inspection of the wheel.
12. Vortex breakers shall be provided on all side inlets and multiple fan plenums

K. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls. Size as required to suit roof opening and fan base.

1. Coordinate curb height with roof insulation thickness, and with other criteria such as snow. Minimum curb height is 18" to provide a minimum of eight (8) inches above finished roof.
2. Design curb to provide positive connection between curb and fan base and curb and building structure.
3. Provide seismic and wind rated curbs when required by seismic and wind loading requirements of this project.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Damper holding tray: For Fans scheduled with dampers.

2.7 MIXED-FLOW FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation
2. Howden Fan Co
3. Loren Cook Company
4. Twin City Fan

B. Description: Direct or belt drive in line mixed flow fan wheel and housing, straightening vane section, fan shaft, bearings, motor, starter and disconnect switch, drive assembly and accessories.

C. Housings: Fabricated of steel coated with electrostatically applied baked polyester urethane.

1. Inlet and Outlet Connections: Outer mounting frame and companion flanges.
2. Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.
3. Mixed-Flow Outlet Connection: flanged discharge perpendicular to fan inlet.

D. Fan wheels: Steel with mixed flow airfoil-shaped blades.

E. Accessories:

1. Mounting Clips: Horizontal or Vertical mounting clips welded to fan housing, of same material as housing.
2. Inlet and Outlet Screens: Wire-mesh screen on fans not connected to ductwork of same material as housing.
3. Inlet Bell: Curved inlet for when fan is not attached to duct, of same material as housing.
4. Inlet Cones: Round-to-round transition of same material as housing.
5. Outlet Cones: Round-to-round transition of same material as housing.

F. Factory Finishes:

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.8 ELECTRICAL

A. Fans shall be supplied with NEMA motor controllers in accordance with mechanical, control and electrical specifications.

B. Disconnect Switch: Nonfusible type, with thermal-overload protection factory mounted. Locate within motor compartment for exterior applications, factory wired to motor.

C. Starter: Single phase motor contactor or three phase combination motor starter/fused disconnect switch with overcurrent protection. Locate remotely in an enclosed location for exterior applications.

D. Direct Drive Speed Controller – Manually adjustable type for constant volume operation and automatic modulating or two speed type for automatic control suitable for PSC or ECM single phase motors.

2.9 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Compliance: In accordance with approved submittals and manufacturer's written installation instructions.

B. Comply with mounting and anchoring requirements for seismic and/or wind installations.

C. Secure fan and curb mounting assemblies to structure with positive attachments in accordance project's seismic loading requirements.

D. Secure exterior fans and curb mounting assemblies to structure with positive attachments in accordance with project's seismic and/or wind loading requirements.

E. Wind and impact certified fans and mounting assemblies additionally shall comply with requirements of current certification. All power wiring, control wiring, controllers, motor starters and unit disconnects shall be concealed and protected from wind and impact by equipment and curb assemblies.

F. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hanger

G. Install floor-mounting units on concrete bases with vibration isolation per specifications.

H. Secure roof-mounting fans to roof curbs with stainless or cadmium-plated hardware. Install units with clearances for service and maintenance. In no case, shall the access and service space around and over fans less than that recommended by manufacturer.

I. Install work readily accessible for normal operation, reading of instruments (in vertical position), adjustment, service, inspection and repair. Provide access panels where indicated and required. Access panels shall be the responsibility of the respective subcontractor.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Install ducts adjacent to fans to allow service and maintenance.

B. For fans with drain, install a drain valve with screwed cap.

C. Provide internal wiring conduits so that all electrical and control wiring penetrates the building envelope within the interior of the roof curb to eliminate exposed wiring and conduit.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fans.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Replace fan and motor pulleys as required to achieve design airflow. After system is balanced, replace the variable pitch sheaves with fixed pitch sheaves.

D. Lubricate bearings.

END OF SECTION 23 3400

SECTION 23 3600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Single-duct air terminal units.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities, pressure loss, furnished specialties, liner/insulation, sound-power ratings, and accessories.

B. LEED Submittal:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.

2. Wiring Diagrams: Power, signal, and control wiring.

D. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Sound Performance: Air Terminal Unit sizing and selection shall include sound performance characteristics. Entire installation shall conform to project Acoustic and Vibration Control requirements of Division 01 Specifications.

C. UL Listing: Meeting UL 181 requirements flame spread, smoke developed, and erosion.

D. NFPA Compliance: NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

E. Performance: Rate air terminal unit performance characteristic data according to ARI 880.

1.4 COORDINATION

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate control wiring, transformer requirements, electrical wiring and electrical disconnect installation.

C. Coordinate DDC controller, automatic temperature controls and instrumentation installation.

D. Coordinate CBC equipment anchorage and seismic bracing requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Manufacturers:

a. Price Industries
b. Siemens
c. Titus.
d. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 SINGLE-DUCT AIR TERMINAL UNITS

A. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.

B. Casing: Minimum 22-gage galvanized steel.
1. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
2. Air Outlet: S-slip and drive connections.

C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 410 rated, 2 percent of nominal airflow at 6-inch wg inlet static pressure.
2. Damper Position: Normally closed.

2.3 REQUIRED ACCESSORIES

A. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Instrumentation and Controls."

B. Control Transformer: For control voltage on electronic control units.

C. Hot-Water Heating Coil: 0.0075" copper, 0.0095" phenolic coated aluminum, or 0.0095" aluminum fins, and 0.017" copper tube, mechanically expanded into copper -plate fins; and factory installed with galvanized casings. Coils shall be factory tested at 350 psi prior to shipment.

D. Attenuator Section: Similar to terminal casing, as specified above. For multi-outlet attenuator section: provide collars; each with locking butterfly balancing damper.

E. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

2.4 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

B. Verification of Performance: Rate air terminal units according to ASHRAE Standard 130 - 1996.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

B. Install air terminal units with seismic bracing where required by code.

C. Reheat coil fins on 100% outside air systems shall be copper, or phenolic coated with stainless steel coil casings.

D. Reheat coil fins on office and lecture hall air systems shall be aluminum.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Shop drawings shall show specific installation locations.

B. Install piping adjacent to air terminal units to allow service and maintenance.

C. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping and Valves," connect heating coils to supply with shutoff valve, strainer, and union or flange; and to return with control valve, automatic flow balancing valve, shutoff valve and union or flange, in accordance with UCI Campus Standard detail drawing.

D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

E. Connect DDC control wiring and control devices according to Division 23 "Instrumentation and Controls."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 23 3600

SECTION 23 3610 - LABORATORY AIRFLOW CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies requirements for laboratory and vivarium airflow and pressure control system.

B. Related Sections include the following:

1. Division 26 Section "Digital Addressable-Fire Alarm Systems" for fire and smoke detectors mounted in HVAC systems and equipment.
2. Division 23 Section “Metal Ducts” for installation requirements.
3. Division 23 Section “Terminal Air Units” for reheat coil, access door, and attenuator requirements.
4. Division 23 Section "Instrumentation and Controls.”
5. Division 26 Section "Common Work Results for Electrical."

1.2 SYSTEM DESCRIPTION

A. A laboratory airflow control system shall be furnished and installed to control the airflow into and out of laboratory rooms. The exhaust flow rate of a laboratory fume hood shall be controlled precisely to maintain a constant average face velocity into the fume hood at either a standard/inuse or standby level based on an operator’s presence in front of the fume hood. The laboratory control system shall vary the amount of make-up/supply air into the room to operate the laboratories at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates and maintain laboratory pressurization in relation to adjacent spaces (positive or negative). The laboratory airflow control system shall be capable of operating as a standalone system or as a system integrated with the Building Management System (BMS). An optional locally mounted user interface terminal shall be available to allow room-level control variables to be displayed, and where appropriate, edited to adjust control operation.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each device noting configuration, assembly and materials of construction. Indicate product performance characteristics including airflow, static pressure, and noise criteria rating for each valve.

1. Installation and startup instructions for each type of product indicated.
2. Manufacturer’s descriptive literature including operating, maintenance, and repair instructions, and parts list.
3. Each control device labeled with setting or adjustable range of control.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. System Communication Diagram: Indicate configuration showing: control devices, power supplies, communications cabling diagrams, interconnections, and system interfaces
2. Control Diagrams: Power, signal, and control wiring.
3. Sequence of Operation: Describe operation of each device, annunciation of each alarm, alarm notification, and interconnects/interfaces with BMS. .
4. Room Schedule indicating equipment specific Tag number and model, valves minimum and maximum airflows, and room offset.

C. Field Startup Reports: Indicate and interpret test results for compliance with performance requirements.

D. Project Record Documents: Record actual locations of air valves, control components, and sensors.

1.4 QUALITY ASSURANCE

A. The laboratory airflow system provider shall be an entity that designs, develops, manufactures and sells products and services to control the environment and airflow of critical spaces using a Quality Management System registered to ISO 9001:2000.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University's Representative, and marked for intended use.

C. Sound Performance: Control Valve unit sizing and selection shall include consideration of sound performance characteristics. Entire installation shall conform to project acoustic and vibration control requirements.

D. NFPA Compliance: NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

E. Performance: Rate air terminal unit performance characteristic data according to ASHRAE Standard 130- 1996. Control Valve unit selection shall be based on maximum pressure drop of 0.6-inches of water column.

F. Identification: Label each Control Valve unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

1.5 COMPLIANCE SCHEDULE

A. Any alternate laboratory airflow control system supplier shall provide a separate compliance schedule, which shall include the section, paragraph and subparagraph of these specifications, and a direct statement to indicate compliance or noncompliance with the requirements. For all areas of noncompliance, the supplier shall describe what specific and alternative approach or approaches

has been taken and document the impact this will have on the sizing of the air delivery systems, the required cooling and heating capacities, energy costs and maintenance of the building.

B. The alternate laboratory airflow control system supplier shall furnish a letter of compliance to the engineer, signed by a corporate officer of the laboratory system manufacturer, certifying the compliance and noncompliance items as stated above 10 days prior to the bid.

1.6 TECHNICAL PROPOSAL

A. Any alternate laboratory airflow control system supplier shall submit a detailed technical proposal for the University's evaluation at the time of submitting the compliance schedule described in section 1.4. The proposal shall describe the manner of compliance with this minimum performance specification, with particular emphasis on the following areas: diversity and energy analysis, proposed equipment, experience and performance verification. This proposal shall be separate from any BMS proposal(s), and it shall include the scope of information and services detailed in paragraphs B through E of this subsection.

B. Diversity and Energy Analysis:

1. Diversity analysis of the sizing of the ductwork, fans, air handlers, chillers, and boilers for the laboratory spaces. The analysis shall be based upon:

Number of Hoods	=	See plans
Occupied Hours	=	*
User Presence Hours	=	*
Sash Position–User Present	=	100%
Sash Position (a)–User Absent	=	100%
Sash Position (b)–User Absent	=	50%
CFM/Ton Cooling	=	175 or *

The analysis shall provide:

Required Exhaust Capacity per Manifold (in CFM)	w/user absent sash position (a) w/user absent sash position (b)
Required Supply Capacity per Manifold (in CFM)	w/user absent sash position (a) w/user absent sash position (b)
Required Cooling Capacity (in tons)	w/user absent sash position (a) w/user absent sash position (b)

2. Energy analysis for the laboratory spaces. The analysis shall be based upon:

Number of hoods	=	See plans
Occupied Hours	=	*
User Presence Hours	=	*
Sash Position–User Present	=	100%
Sash Position (a)–User Absent	=	100%
Sash Position (b)–User Absent	=	50%

$/CFM = *

The analysis shall provide:

Energy Costs w/user absent sash position (a)

w/user absent sash position (b)

* *Actual project parameters as defined by the University*

C. Proposed Equipment:

1. The laboratory airflow control system supplier shall provide a detailed proposal describing all elements of the laboratory control system. A schematic laboratory layout shall be provided, showing relations of these elements and a description of how they interact.
2. Technical specification data sheets shall be provided for all proposed system components and devices.
3. All proposed airflow control devices shall include discharge, exhaust and radiated sound power level performance obtained from testing in accordance with ASHRAE Standard 130-1996.

D. Experience:

1. The laboratory airflow control system supplier shall provide a list of at least three similar laboratory airflow control systems installed in California as part of this proposal.
2. The laboratory airflow control system supplier shall provide the names, addresses and telephone numbers of the consulting engineer and the University's representative for each of these installations. It is understood that these individuals may be contacted regarding timely delivery, the quality of installation, the operation and performance of the equipment and the service requirements for each installation. Unsatisfactory performance or inability to provide references shall be grounds for rejection.

E. Performance Verification: The laboratory airflow control system supplier shall demonstrate a typical laboratory space that includes multiple fume hoods, a general exhaust and a supply airflow control device for the purpose of verifying the laboratory airflow control system's ability to meet the performance requirements indicated in this specification. All travel and lodging costs to witness the performance verification shall be the responsibility of the laboratory airflow control system supplier.

1.7 SYSTEM PERFORMANCE REQUIREMENTS

A. Airflow Control System Description:

1. Each laboratory shall have a dedicated laboratory airflow control system. Each dedicated laboratory airflow control system shall support a minimum of 20 network controlled airflow devices.

2. The laboratory airflow control system shall employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow to maintain a constant face velocity over a minimum range of 20% to 100% of sash travel. The corresponding minimum hood exhaust flow turndown ratio shall be 5 to 1.
3. The hood exhaust airflow control device shall respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position (with no more than 5% overshoot/undershoot) of required airflow. Rate of sash movement shall be from one to one and one-half feet per second.
4. The hood exhaust airflow control device shall be switched automatically between in-use and standby levels based on the operator's presence immediately in front of the hood. A presence and motion sensor shall activate the switching. The airflow control device shall achieve the required in-use commanded value in less than one second from the moment of detection with no more than a 5% overshoot or undershoot.
5. The laboratory airflow control system shall maintain specific airflow (±5% of signal within one second of a change in duct static pressure) regardless of the magnitude of the pressure change, airflow change or quantity of airflow control devices on the manifold (within 0.6" to 3.0" wc).
6. The laboratory airflow control system shall use volumetric offset control to maintain room pressurization. The system shall maintain proper room pressurization polarity (negative or positive) regardless of any change in room/system conditions, such as the raising and lowering of any or all fume hood sashes or rapid changes in duct static pressure. Systems using differential pressure measurement or velocity measurement to control room pressurization are unacceptable.
7. The laboratory airflow control system shall maintain specific airflow (±5% of signal) with a minimum 16 to 1 turndown to ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.

1.8 SOUND SPECIFICATION

A. Refer to Division 01 for project sound performance criteria. Select valve assemblies and attenuators to meet project requirements.

B. Unless otherwise specified, the airflow control device shall meet the NC levels specified for each space.

C. If the airflow control device cannot meet the sound power level specification, a properly sized silencer or sound attenuator must be used.

D. All proposed airflow control devices shall include discharge, exhaust and radiated sound power level performance.

1.9 COORDINATION

A. Coordinate power requirements with Division 26. Division 26 shall provide 120 VAC power to each laboratory airflow control panel. The power circuits shall be dedicated to the laboratory airflow control system and connected to the emergency system.

B. Coordinate equipment installation ensuring unit maintenance space and clearance requirements are provided.

1.10 PREVENTIVE MAINTENANCE

A. The laboratory airflow control system supplier shall provide at no additional cost to the University during and after the warranty period five years of required preventive maintenance on all airflow sensors (e.g., pitot tube, flow cross, orifice ring, air bar, hot wire, vortex shedder, side wall sensors, etc.) and flow transducers provided under this section. Airflow sensors shall be removed, inspected, and cleaned annually during the five-year period to prevent inaccuracies due to long-term buildup from corrosion, lab tissues, wet or sticky particles, or other materials that foul the sensor. If impractical to remove the airflow sensors, the laboratory airflow control system supplier shall include in the proposal the cost of supplying and installing duct access doors, one for each sensor. The transducer shall be checked and recalibrated annually to ensure long-term accuracy. Note that auto-zero recalibration of transducers is not acceptable as a substitute for annual recalibration.

1.11 WARRANTY

A. Warranty shall commence upon the date of Substantial Completion and extend for a period of 36 months, whereupon any defects in materials or laboratory airflow control system performance shall be repaired by the supplier at no cost to the University.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Phoenix Control Corporation.
2. Siemens.
3. Tek-Air
4. CEL

2.2 USAGE BASED CONTROL EQUIPMENT

A. For variable air volume (VAV) systems, a sash sensor shall be provided to measure the height of each vertically moving fume hood sash. A sash sensor shall also be provided for horizontal overlapping sashes. Control systems employing sidewall-mounted velocity sensors shall be unacceptable. Coordinate vertical/horizontal sash sensor requirements with lab drawings.

B. A presence and motion sensor shall be provided to determine an operator's presence in front of a hood by detecting the presence and/or motion of an operator, and to command the laboratory airflow control system from an in-use operating face velocity (e.g., 100 fpm) to a standby face velocity (e.g., 60 fpm) and vice versa. When the sensor detects the presence and/or motion of an operator within the detection zone, it shall command the system to the in-use face velocity within 1.0 second. Wide area motion detectors (on the hood or room level) shall be unacceptable

C. The airflow at the fume hood shall vary in a linear manner between two adjustable minimum and maximum flow set points to maintain a constant face velocity throughout this range. A minimum volume flow shall be set to assure flow through the fume hood even with the sash totally closed.

D. A fume hood monitor shall be provided to receive the sash sensor output and presence and/or motion signal. The same monitor shall generate an exhaust airflow control signal for the appropriate airflow control device in order to provide a constant average face velocity. Audible and separate visual alarms shall be provided for both flow alarm and emergency exhaust conditions. A push button switch shall be provided to mute the audible alarm. Muting of the alarm shall only silence the audible portion, while the visual alarm shall be maintained until the low flow condition has returned to normal. The mute mode is automatically reset when the alarm condition ceases.

2.3 AIRFLOW CONTROL DEVICE

A. The airflow control device shall be a single blade damper or VAV terminal or venturi valve.

B. The valve assembly manufacturer's Quality Management System shall be registered to ISO 9001:2000.

C. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.

D. The airflow control device shall maintain accuracy within ±5% of signal over an airflow turndown range of no less than 16 to 1.

E. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.

F. The airflow control device shall be constructed of one of the following three types:

1. Class A—The airflow control device for non-corrosive airstreams, such as supply and general exhaust, shall be constructed of 16-gauge aluminum. The device's shaft and shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting

   link shall be made of aluminum. The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be made of a Teflon, polyester or PPS (polyphenylene sulfide) composite. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge

galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.

2. Class B—The airflow control device for corrosive airstreams, such as fume hoods and biosafety cabinets, shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of a Teflon or PPS (polyphenylene sulfide) composite.
3. Class C—The airflow control device for highly corrosive airstreams shall be constructed as defined in Paragraph F.2. In addition, these devices shall have no exposed aluminum or stainless steel components. Shaft support brackets, pivot arm, internal mounting link, and pressure independent springs shall have a baked-on, corrosion-resistant phenolic coating in addition to the materials defined in paragraph F.2. The internal nuts, bolts, and rivets shall be titanium or phenolic coated stainless steel. Only devices for highly corrosive environment applications, and those clearly defined as “high corrosion resistant” on project drawings will require this construction.

G. Actuation:

1. For electrically actuated VAV operation, a UL 916 listed electronic actuator shall be factory mounted to the valve. Loss of main power shall cause the valve to position itself in an appropriate failsafe state. Options for these failsafe states include: normally open maximum position, normally closed-minimum position and last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications).
2. Constant volume valves do not require actuators.

H. The controller for the airflow control devices shall be microprocessor based and operate using peer-to-peer control architecture. The room-level airflow control devices shall function as a standalone network.

I. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each laboratory control system shall have the capability of performing fume hood control, pressurization control, temperature control, humidity control, and implement occupancy and emergency mode control schemes.

J. The laboratory airflow control systems shall have the option of digital integration with the BMS.

K. Certification:

1. Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of no more than ±1% of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated

and their accuracy verified to ±5% of signal at a minimum of 48 different airflows across the full operating range of the device.

2. Each airflow control devices shall be marked with device-specific factory calibration data. At a minimum, it should include the tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation.

L. Airflow control devices that are not venturi valves and airflow measuring devices (e.g., pitot tube, flow cross, air bar, orifice ring, vortex shedder, etc.) shall only be acceptable, provided these meet all the performance and construction characteristics as stated throughout this specification and:

1. The airflow control device employs transducers manufactured by Rosemount, Bailey, Bristol, or Foxboro. Accuracy shall be no less than ±0.15% of span (to equal ±5% of signal with a 15 to one turndown) over the appropriate full-scale range, including the combined effects of nonlinearity, hysteresis, repeatability, drift over a one-year period, and temperature effect.
2. Airflow sensors shall be of a multi-point averaging type, 304 stainless steel for all supply and general exhaust applications, 316L stainless steel for all fume hood, canopy, snorkel, and biosafety cabinet applications. Single point sensors are not acceptable.
3. Suppliers of airflow control devices or airflow measuring devices requiring minimum duct diameters shall provide revised duct layouts showing the required straight duct runs upstream and downstream of these devices. Coordination drawings reflecting these changes shall be submitted by the supplier of the laboratory airflow control system. In addition, suppliers shall include static pressure loss calculations as part of their submittals. All costs to modify the ductwork, increase fan sizes and horsepower and all associated electrical changes shall be borne by the laboratory airflow control supplier.

2.4 EXHAUST AND SUPPLY AIRFLOW DEVICE CONTROLLER

A. The airflow control device shall be a microprocessor-based design and shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.

B. The airflow control device shall store its control algorithms in non-volatile, re-writeable memory. The device shall be able to stand alone or be networked with other room-level digital airflow control devices using an industry standard protocol. The controller shall operate using peer-topeer control architecture. The room-level airflow control devices shall function as a standalone network.

C. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each laboratory control system shall have the capability of performing fume hood control, pressurization control, temperature control, humidity control, and implement occupancy and emergency mode control schemes

D. The airflow control device shall use industry standard 24 Vac power.

E. The airflow control device shall have provisions to connect a notebook PC commissioning tool and every node on the network shall be accessible from any point in the system.

F. The airflow control device shall have built-in integral input/output connections that address fume hood control, temperature control, humidity control occupancy control, emergency control, and non-network sensors switches and control devices. At a minimum, the airflow controller shall have:

1. 3 universal inputs capable of accepting 0 to 10 Vdc, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3 10 K ohm @ 25 degree C thermistor temperature sensors.
2. 1 digital input capable of accepting a dry contact or logic level signal input.
3. 2 analog outputs capable of developing either a 0 to 10 Vdc or 4 to 20 mA linear control signal.
4. 1 Form C (SPDT) relay output capable of driving up to 1 A @ 24 Vac/Vdc.

G. The airflow control device shall meet FCC Part 15 Subpart J Class A and be UL916 listed.

2.5 VIVARIUM AND OFFICE AIRFLOW CONTROL DEVICE

A. The airflow control device shall maintain a temperature set point by controlling the airflow and the reheat valve in response to a room temperature sensor. If the airflow supply device is not required for make-up airflow control for fume hoods, then the one-second speed of response, and fail-safe conditions required of the laboratory airflow control system shall not apply.

2.6 CONSTANT VOLUME AIRFLOW CONTROL DEVICE

A. The airflow control device shall maintain a constant airflow setpoint. It shall be factory calibrated and set for the desired airflow. It shall also be capable of field adjustment for future changes in desired airflow.

2.7 LOCAL DISPLAY UNIT

A. The control system shall have an optional local display option that allows control and system variables to be displayed on a user interface terminal device. The Local Display Unit shall connect to the room-level network and provide access to all room-level control data.

B. The display unit shall be powered by 24 Vac or 24 Vdc.

C. The Local Display Unit shall have the provisions of being flush mounted or surface mounted either directly to a standard electrical enclosure or DIN rail. Electrical conductors shall terminate inside the display module housing to a pluggable terminal block.

D. The display unit shall utilize an LCD display with variable contrast adjustment and backlighting to adapt the display to various lighting conditions.

E. The display unit shall provide a means of entering and displaying a unique location descriptor that may be used to identify the location and/or function of the display unit. The descriptor shall allow up to two lines of at least 13 alphanumeric characters to be entered in the description field.

F. The display unit shall allow access to pertinent flow, temperature, humidity, pressure data, as well as occupancy and emergency mode control status, and current device or system alarm status. Data shall be viewable in units of measure appropriate for users of the system.

G. The display unit shall have the ability to display up to 250 parameters, organized into display screens of up to five parameters per screen. Each screen shall have the ability to have a descriptive name of up to 16 alphanumeric characters for ease of navigation. Each parameter being displayed shall have the ability to include such information as:

1. Descriptive tag (up to 13 alphanumeric characters).
2. Present value, which may be read directly off the network, or conditioned with a fixed multiplier and/or offset to scale the value for the desired units of measure.
3. Units of measure, which are configurable based on local user conventions.

H. Set points and editable control parameters shall be viewable on the Local Display Unit. The user shall have the ability to enable a pass code to prevent unauthorized changes to set points and editable control parameters.

2.8 CONTROL FUNCTIONS

A. The airflow control devices shall utilize a peer-to-peer, distributed control architecture to perform room-level control functions. Master/Slave control schemes shall not be acceptable. Control functions shall at a minimum include, pressurization, temperature, humidity control and respond to occupancy and emergency control commands.

B. Pressurization Control

1. The control system shall control supply and auxiliary exhaust airflow devices in order to maintain a volumetric offset (either positive or negative). Offset shall be maintained regardless of any change in flow or static pressure. This offset shall be field adjustable and represents the volume of air, which will enter (or exit) the room from the corridor or adjacent spaces.
2. The pressurization control algorithm shall sum the flow values of all Supply and Exhaust airflow devices and command appropriate controlled devices to new set points to maintain the desired offset. The offset shall be adjustable.
3. The pressurization control algorithm shall consider both networked devices, as well as:

    a. Up to three (3) non-networked devices providing a linear analog flow signal.
    b. Any number of Constant Volume devices where the total of supply devices and the total of exhaust devices may be factored into the pressurization control algorithm.

4. Volumetric offset shall be the only acceptable means of controlling room pressurization. Systems that rely on differential pressure as a means of control shall provide documentation to demonstrate that space pressurization can be maintained if fume hood sashes are changed at the same time a door to the space is opened.

5. The Pressurization control algorithm shall support the ability to regulate the distribution of total supply flow across multiple supply airflow control devices in order to optimize air distribution in the space.

C. Temperature Control:

1. The laboratory control system shall regulate the space temperature through a combination of volumetric thermal override and control of reheat coils and/or auxiliary temperature control devices. The critical control system shall support up to four separate temperature zones for each pressurization zone. Each zone shall have provisions for monitoring up to five (5) temperature inputs and calculating a straight-line average to be used for control purposes. Separate cooling and heating set points shall be writable from the BMS, with the option of a local offset adjustment.
2. Temperature control shall be implemented through the use of independent primary cooling and heating control functions, as well as an auxiliary temperature control function, which may be used for either supplemental cooling or heating. Cooling shall be provided as a function of thermal override of conditioned air with both supply and exhaust airflow devices responding simultaneously so as to maintain the desired offset. Heating shall be provided through modulating control of a properly sized reheat coil.
3. The auxiliary temperature control function shall offer the option of either heating or cooling mode and to operate as either a stand-alone temperature control loop, or staged to supplement the corresponding primary temperature control loop.

D. Humidity Control:

1. The laboratory control system shall have an embedded humidity control function, which allows the monitoring and control of the relative humidity level in the pressurized zone. Using peer-to-peer control, the airflow devices shall have the ability to monitor the relative humidity level of the space and, based on a BMS writable set point, develop a control signal to drive one or the other humidification or dehumidification control circuits.
2. The humidity control loop(s) shall share a common set point, with a configurable dead band adjustment to prevent the humidification and dehumidification control functions to operate at the same time.

E. Occupancy Control:

1. The control system shall have the ability to change the minimum air change rate, based on the occupied state, in order to reduce energy consumption when the space is not occupied. The occupancy state may be set by either the BMS as a scheduled event or through the use of local occupancy or switch. The laboratory control system shall support a local occupancy override button that allows a user to override the occupancy mode and set the space to occupied for a predetermined interval. The local occupancy sensor/switch or bypass button shall be given priority over a BMS command.

F. Emergency Mode Control:

1. The laboratory control system shall provide a means of overriding temperature and pressurization control in response to a command indicating an emergency condition exists, and airflow control devices are to be driven to a specific flow set point. The system shall support up to four emergency control modes. The emergency control modes may be initiated either by a local contact input or BMS command.
2. Once an emergency mode is invoked, pressurization and temperature control are overridden for the period that the mode is active. Emergency modes shall have a priority scheme allowing a more critical mode to override a previously set condition.

G. Local Alarm Control:

1. The laboratory control system shall provide the means of summing selective alarm activity at the room-level network and generating a local alarm signal. The local alarm signal may be directed to any available output, as well as to the BMS. The alarm mask may be configured differently for each room-level system.

H. Diversity Alarm:

1. The laboratory control system shall have the ability of monitoring the airflow values for the pressurized space and generating an alarm signal in the event the total exhaust flow exceeds a predetermined threshold. The diversity alarm is intended to allow the user to take diversity in the design and generate an alarm condition in the event the diversity threshold is compromised. This function must be available in either an integrated or standalone system.

I. Fume Hood Control:

1. Airflow devices intended to control the face velocity of a fume hood shall have the ability to interface directly with the fume hood monitoring device. The airflow control device shall:

    a. Accept command inputs to regulate the flow accordingly and make this command value available to the BMS
    b. Accept a sash position signal and make this value available to the BMS.
    c. Accept a Usage Based Control signal to indicate user presence and make this signal available to the BMS
    d. Provide a flow feedback signal to the fume hood monitor, which may be used for calculating face velocity or to confirm the airflow device has achieved the proper flow rate and make this value available to the BMS.
    e. Provide alarm signals to the fume hood monitor in the event the airflow device is unable to achieve the proper flow rate, there is a loss of static pressure indicating improper fan operation, or there is a loss of power to the airflow control device, in order to provide a local alarm indication. The fume hood airflow control device shall respond to changes in sash position and user presence within 1 second, in order to provide a constant 100-feet-per-minute face velocity when the fume hood is in use.

J. The laboratory control system shall be segregated into subnets to isolate network communications to ensure room-level control functions and BMS communications are carried out reliably. Each

laboratory space or pressurization zone shall be its own subnet. Commercially available routers shall be used to provide this isolation.

K. The laboratory airflow control system shall support at least 20 networked devices in each pressurized zone.

L. All points shall be available through the interface to the BMS for trending, archiving, graphics, alarm notification and status reports. Laboratory airflow control system performance (speed, stability and accuracy) shall be unaffected by the quantity of points being monitored, processed or controlled.

M. Refer to the BMS specification for the required input/output summary for the necessary points to be monitored and/or controlled.

2.9 INTERFACE TO BUILDING DDC SYSTEM

A. The laboratory airflow control system network shall have the capability of digitally interfacing with the BMS using BACnet communication protocol. The required software interface drivers shall be developed and housed in a dedicated interface device (gateway) furnished by the critical airflow control system supplier.

B. All room-level points shall be available to the BMS for monitoring or trending. The gateway shall maintain a cache of all points to be monitored by the BMS. The room-level airflow control devices shall update this cache continually.

C. The building-level network shall be a high-speed (1.25 mbps) communications protocol. The building-level network shall support up to one hundred (100) sub nets, or pressurization zones, or six thousand (6,000) data points.

D. A commercially available interface card shall be provided with the gateway in order to connect to the building-level network.

E. A commercially available network interface card shall be provided with the gateway to interface with the BMS.

PART 3 – EXECUTION

3.1 INSTALLATION

A. The automatic temperature controls (ATC) contractor shall install the sash sensors, interface boxes, presence and motion sensor, and fume hood monitor on the fume hood. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels. Sash interface boxes with interface cards shall be mounted in an accessible location.

B. Fume hood manufacturer shall provide cutout for the fume hood monitors.

C. The ATC contractor shall install all routers and repeaters in an accessible location in or around the designated laboratory room.

D. The ATC contractor shall install an appropriately sized and fused 24 VAC transformer suitable for NEC Class II wiring.

E. All cable shall be furnished and installed by the ATC contractor. The ATC contractor shall terminate and connect all cables as required. The ATC shall utilize cables specifically recommended by the laboratory airflow controls supplier.

F. The mechanical contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.

G. The mechanical contractor shall provide and install all reheat coils and transitions.

H. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.

I. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC."

3.2 SYSTEM STARTUP AND TRAINING

A. System start-up shall be provided by a factory-authorized representative of the laboratory airflow control system manufacturer. Start-up shall include calibrating the fume hood monitor and any combination sash sensing equipment as required. Start-up shall also provide electronic verification of airflow (fume hood exhaust, supply, make-up, general exhaust or return), system programming and integration to BMS.

B. The balancing contractor shall be responsible for final verification and reporting of all airflows.

C. The laboratory airflow control system supplier shall furnish a minimum of eight hours of University personnel training by factory trained and certified personnel. The training will provide an overview of the job specific airflow control components, verification of initial fume hood monitor calibration, general procedures for verifying airflows of air valves and general troubleshooting procedures.

D. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee.

3.3 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by University’s Representative, to adjust and calibrate components and to assist University's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

END OF SECTION 23 3610

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles some of which may not be applicable to this project.

B. Related Sections include the following:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

C. Samples for Verification: For diffusers, registers, and grilles to be provided in other than baked white enamel the University’s Representative may request a sample in the manufacturer's standard sizes to select and verify alternate color.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

    a. Price Industries.
    b. Titus.
    c. Or equal.

2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 SUPPLY AIR OUTLETS

A. Louver Face Diffuser - CD:

1. Titus model MCD.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Panel Size: 24” x 24”.
5. Mounting: Lay-in T-bar.
6. Pattern: modular core, field adjustable.
7. Dampers: None.
8. Accessories: Square to round neck adaptor, if needed.
9. Adjust modules in field to provide air pattern required.
10. For hard ceilings, provide surface mount beveled drop face border type 6. Panel size not required.

B. Ceiling Diffuser – optional type to CD specified above:

1. Titus model OMNI.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Panel Size: 24” x 24”.
5. Mounting: Lay-in T-bar.
6. Pattern: horizontal air with directional blow clip.
7. Dampers: None.
8. Accessories: Direction blow clips..
9. Provide blow clips in field to provide air pattern required.
10. For hard ceilings, provide surface mount full face border type 1. Panel size not required.

C. Sidewall Supply Register – SWR (if needed on project):

1. Titus model 300RL.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Adjustable horizontal or vertical to suit installation and air flow with blades spaced at 3/4 inch apart unless otherwise required.

5. Rear Blade Arrangement: alternate of face blade with same blade spacing. .
6. Frame: 1-1/4 inches wide.
7. Mounting: Wall with concealed screws.
8. Damper Type: None.
9. Accessories: Front-blade gang operator.

2.3 RETURN, TRANSFER AND EXHAUST AIR INLETS

A. Perforated Face Ceiling Grille - CR:

1. Titus model PAR.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Arrangement: Perforated core.
5. Panel Size: 24" x 24".
6. Mounting: Lay-in T-bar.
7. Damper: None.
8. Accessories: Square to round neck adaptor, if needed.
9. For hard ceilings, provide surface mounting face border type 1. Panel size not required.

B. Fixed Face Wall Grille or Register – TG & SWE (if needed on project):

1. Titus model 350RL.
2. Material: Steel, or Stainless steel.
3. Finish: Baked enamel, white. Or Stainless steel, mill.
4. Face Blade Arrangement: Fixed horizontal or vertical to suit installation at 3/4 inch apart at 35° angle.
5. Rear Blade Arrangement: alternate of face blade with same blade spacing. .
6. Frame: 1-1/4 inches wide.
7. Mounting: Wall with concealed screws.
8. Damper Type: Adjustable opposed-blade assembly for registers only.

C. Eggcrate Ceiling Grille - TG & EG (if needed on project):

1. Titus model 50F.
2. Material: Aluminum.
3. Finish: Natural anodized.
4. Face: ½" x ½" x ½" grid.
5. Panel Size: 24" x 24".
6. Mounting: Lay-in T-bar.
7. Damper: none. Ceiling registers shall be type ER and have opposed blade damper.
8. Accessories: Square to round neck adaptor, if needed.
9. For hard ceilings, provide plaster frame with concealed screws. Panel size not required.

D. Adjustable Bar Register

1. Material: Steel, Aluminum or Stainless steel.
2. Finish: Baked enamel, white.

3. Face Blade Arrangement: Adjustable horizontal Adjustable vertical spaced 3/4 inch apart.

4. Rear Blade Arrangement: Adjustable horizontal Adjustable vertical spaced 3/4 inch apart.

5. Mounting: Concealed.

2.5

2.6 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, “Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, units shall be furnished with metal panel. Where architectural features or other items conflict with installation, notify the University’s Representative for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Provide stainless steel exhaust grilles in showers, dark rooms, sterilizer area, glass wash areas, and other moisture areas.

E. Provide outlets with gaskets and install so that there will be no streaking of the walls or ceilings due to leakage.

F. Grilles and diffusers shall match all qualities, including appearance, throw, noise level, adjustability, etc.

G. Locations of diffusers, registers and grilles shall be coordinated as not to interfere with light fixtures and sprinkler heads and also be located in accordance with the following:

1. Supply and return grilles shall create efficient cross ventilation in the room.
2. Exhaust grilles in restrooms shall be located near water closets.
3. Transfer air inlets in restrooms shall be located as farthest from exhaust grille.
4. Airflow within the room shall minimize the effects of door operation.
5. Return grilles shall be located near windows to offset heat gain/loss.

H. Air Distribution within the laboratories is critical. Supply diffusers shall be positioned such that air discharge does not affect the operation of the fume hoods. The terminal velocity shall be 50 fpm at 2 feet from the face of any fume hood and 50 fpm at 6 feet above the floor. Provide a laminar flow ceiling panel if these requirements can be meet with design layout. J. Exhaust grilles shall be 45° angled blades type only.

K. Opposed blade dampers in necks of ceiling diffusers are a source for noise generation and shall not be provided. Volume damper shall be provided in upstream ductwork to balance airflow.

L. Air throw from supply air diffusers shall not be directed towards the face of laboratory hoods.
L. Grilles, registers and diffusers shall be selected to perform without distracting noise. Throw, drop, and NC values shall be analyzed during design layout.

M. Painting inside of ducts behind grilles is not allowed in order to avoid any IAQ issues.

N. Install regular style diffusers and grilles in regular type lay-in acoustic tile ceilings.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 3713

SECTION 23 4100 – PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

B. Related Section includes the following:

1. Division 23 Section “Custom Air-Handling Units”.
2. Division 23 Section “Air Duct Accessories”.

1.2 DEFINITIONS

A. DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate.

1.3 SUBMITTALS

A. Product Data: Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.

1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.

D. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Comply with ARI 850.

C. Filters shall conform to UL 900, Class 2.

D. Comply with ASHRAE 52.2 Appendix J for method of establishing MERV-A performance rating.

E. Replaceable filter face velocity shall correspond to cooling coil face velocity within ± 5 percent.

F. Gaskets shall be provided to prevent infiltration of air around filters.

G. Filter frames shall be constructed of corrosion-resistant material.

H. Provide sealant, or gasket, around edges of High Efficiency filter frames.

I. Provide filters for outside air and/or return air. Provide replaceable (throwaway) and/or high efficiency type.

J. High efficiency filter assembly shall include holding frame and fastener assembly, filter cartridge/housing, mounting frame, and retainer assembly. Filters shall be high flow capacity type with low-pressure drop.

1.5 COORDINATION

A. Coordinate filter array size with AHU manufacturer using 24” x 24” filters only.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one complete set of pre-filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Filters and Filter-Holding Systems:

a. Aerostar
b. Burk Enviromnmeital
c. Califilter
d. Camfil/Farr Co.
e. Flanders Filters, Inc.

f. Luwa

2. Filter Gages:

a. Airguard Industries, Inc.
b. Dwyer Instruments, Inc.

2.2 DISPOSABLE PANEL FILTERS

A. Manufacturer: Camfil Farr 30/30, Flanders Pre Pleat HV, Aerostar

B. Description: MERV 8, factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with holding frames.

C. Media: Interlaced glass fibers sprayed with nonflammable adhesive and anti-microbial agent. Filter shall be UL Class 1.

D. Frame: Cardboard/beverage board frame with perforated metal retainer. Chemically bonded to the filter pack.

1 PRE-FILTERS/MOISTURE ELIMINATOR

a Manufacturer: Califilter Califog, medium efficiency type or Burke Aero-Mist 40.

b The Pre-filter/Moisture Eliminator shall be a medium efficiency, extended area, disposable type of the quantity and size indicated on the drawings.

c The filter media shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE Standard 52.2-1999. It shall have an average atmospheric dust spot efficiency of 30 % on ASHRAE Test Standard 52-.1-92. It shall have an average synthetic dust arrestance of 90% in accordance with that test standard.

d Media shall be antimicrobial treated.

e The filter shall be listed by Underwriters' Laboratories as UL 900 Class 2.

2.5 V-BANK CELL FILTERS

A. Manufacturer: Aerostar FP Mini-Pleat, Camfil Farr Durafil ES, Flanders Super Flow V or Luwa FP.

B. Description: 12" thick MERV 14A (95%) Factory-fabricated, disposable, packaged air filters with media packs angled to airflow, and with holding frames.

C. Filter Unit Class: UL 900, Class 2.

D. Media: Water resistant micro-fine fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports.
E. Initial resistance at 500 fpm approach velocity shall not exceed .36" w.g.
F. The filter shall be capable of withstanding 10" w.g. without failure of the media pack

G. Filter-Media Frames: Galvanized steel, Polypropylene, or impact-resistant plastic.

H. Face Gasket: Neoprene expanded rubber.

2.7 FRONT- ACCESS FILTER FRAMES

A. Duct-Mounting Frames: Welded galvanized steel with gaskets and fasteners suitable for bolting together into built-up filter banks.

B. Framing System: Galvanized steel framing members with access for upstream (front) filter servicing, cut to size and pre-punched for assembly into modules.

1. 16-gauge welded galvanized steel construction, a 3/4" filter sealing flange and filter centering dimples for ease of installation.
2. Vertically support filters with heavy gage galvanized steel stiffeners to prevent deflection of horizontal members without interfering with either filter installation or operation.
3. Polyurethane gasketing on the frame to filter sealing surface to assure leak free performance in the most demanding of applications.
4. Pre-drilled holes for bolt-together installation of built-up banks.
5. Multiple lances for the application of varying fasteners to install a wide variety of standard size air filter.
6. Four galvanized fasteners per filter.

C. Prefilters: Incorporate a separate track, removable from front on duct mounted assemblies, and if required.

D. Sealing: Factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air.

2.8 FILTER GAGES

A. Description: Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

1. Diameter: 4-1/2 inches similar to Dwyer 2000 Series.
2. Range: 0- to 2.0-inch wg, except HEPA filters shall be 0-3.0-inch wg.

B. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For filter efficiencies greater than 65%, V-Bank type filters shall be provided.

B. Install filter holding frames according to manufacturer's written instructions.

C. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

D. Install filters in position to prevent passage of unfiltered air.

E. Install filter gage for each filter bank.

F. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position.

G. Coordinate filter installations with duct and air-handling unit installations.

3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air distribution systems, clean filter housings and install new filter media.

3.4 CONSTRUCTION PHASE

A. Provide temporary 30% pre-filters for adjacent buildings at air intakes within 150 feet of construction zone. Provide weekly filter changes if necessary for the duration of the construction cycle.

END OF SECTION 23 4100

SECTION 23 5100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Listed double-wall boiler breeching or chimney stack.

B. Related Sections include the following:

1. Division 23 Section "Water Tube Boilers" for induced-draft and mechanical fans, and for motorized and barometric dampers.

1.2 SUBMITTALS

A. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data.

B. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

C. Seismic Engineering: Seismic bracing and support design, mounting hardware and equipment, support systems, restraint systems, anchorage systems, and installation shall conform to the

CBC requirements for Seismic Zone 4. Submit calculations, plans, and documents stamped by a qualified California registered engineer.

D. Structural Review: Seismic engineering submittal documents, seismic loads, wind loads, anchorage and support loads, and vertical loads applied to building structures and structural components shall be reviewed, analyzed, and approved by the project structural engineer of record.

E. Flues, vents, chimneys, and breeching materials, designs, and installation shall be UL approved, and shall conform to the requirements of the California Mechanical Code.

F. Flues, vents, and chimney termination locations shall be designed with project Wind Study analysis and results, and shall be subject to review and approval of the University's Representative. Termination location points shall be optimized to minimize impact to building being served as well as adjacent buildings, and surrounding campus environment.

1.4 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FOR LISTED VENTS

A. Manufacturers: Subject to compliance with requirements, provide products from one of listed companies.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 LISTED TYPE B AND BW VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Metal Products; MASCO Corporation.
2. Heat-Fab, Inc.
3. Industrial Chimney Company.
4. Metal-Fab, Inc.
5. Selkirk Inc.; Selkirk Metalbestos and Air Mate.

6. Simpson Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.
7. Van-Packer Company, Inc.
8. Or equal.

B. Description: Double-wall metal vents tested according to UL 103 for continuous operation at 1400° F and intermittent operation at 1800° F.

C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.

D. Inner Shell: Type 304 stainless steel. E. Outer Jacket: Galvanized or Aluminized steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.

2.3 LISTED SPECIAL GAS VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Heat-Fab, Inc.
2. Metal-Fab, Inc.
3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
4. Or equal.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.

D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

E. Outer Jacket: Stainless steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Type B and BW Vents: Vents for certified gas appliances.

B. Listed Special Gas Vent: Boilers.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in the direction of flow.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 23 5100

SECTION 23 5239 - FIRE-TUBE BOILER SKID PACKAGE

PART 1 - GENERAL

1.1 DESCRIPTION

1. This section specifies a steam skid assembly complete with two (2) boilers, a common return system, chemical treatment systems, and blowdown separator. Skid will be manufactured and assembled with single point connections for steam make-up water, condensate return, natural gas, drain, and electrical power.

1.2 RELATED WORK

A. Section 01 33 23, Shop Drawings, Product Data, and Samples.

B. Section 09 91 00, painting.
   1. Section 23 05 11, Common Work Results for HVAC

C. Section 23 08 00, Commissioning of HVAC Systems.

1.3 QUALITY ASSURANCE

A. Coordinate all new and existing equipment and conditions. This includes, but is not limited to: boiler, boiler trim, burner, fuel valve and piping trains, gas pressure regulators and available gas pressure, required fuel oil train pressures and fuel oil header back pressure regulator on house oil pump set, compressed air system for oil atomization, control systems, economizer (if provided), breeching and stacks.

B. Provide written certification that the entire assembly has been coordinated to achieve the required performance and to provide the required features.

C. The model and size of the proposed burner shall have been applied to at least three fire tube boilers which are similar in size, proportion, number of passes and furnace dimensions to the proposed boiler. In each of the three installations, burner performance shall have conformed to requirements specified in the subparagraph, "performance" under the article, burner, and fuel trains of part 2. Provide list of these installations, and name, address, and telephone number of person familiar with each project who will serve as a reference source.

D. Regardless of fuel input rating, the equipment, installation and operation shall conform to NFPA 85. Where conflicts exist between NFPA 85 and this specification, this specification will govern.

1.4 SUBMITTALS

A. Before executing any work, submit in accordance with section 01 33 23, shop drawings, product data, and samples.

B. Boiler:
   1. Complete catalog information and outline drawings of boiler, burner, and accessories with dimensions including tube removal space and access door opening space.
   2. Catalog cuts showing arrangement and construction of pressure parts, casing, internals, and support frame.
   3. Piping connection sizes, locations, types (threaded or flanged).
   4. Technical data including temperature rating and arrangement of refractory and insulation.
   5. Steam nozzle construction. Capability of steam nozzle and attachment to boiler shell to withstand forces and moments imposed by connecting piping.
   6. Amount of heating surface and combustion volume.
   7. Weight of boiler empty and flooded including burner and boiler and burner accessories.
   8. Design pressures and temperatures.
   9. Loading diagram of support frame. Evidence that boiler support requirements have been coordinated with foundation design.
   10. Recommended anchorage of boiler support frame to foundation.
   11. Furnace viewport construction, locations.
   12. Dimensioned location of normal water line, lowest and highest permissible water level, set points of water level alarms and cutoffs.
   13. Predicted external surface temperature of front, rear and sides of boiler.
   14. Seismic design data on boiler and anchorage of boiler to foundation. Refer to section 13 05 41, seismic restraint requirements for non-structural components.

C. Boiler trim: includes bottom blowoff valves, water level alarm and cutoff devices, water level gage, low water cutoffs, piping, all valves and fittings furnished by boiler manufacturer, feedwater control system, steam safety valves, steam pressure gage, stack thermometer, draft gage, and steam pressure switches.
   1. Design, construction, arrangement on the boiler.
   2. Pressure and temperature limitations.
   3. ASTM numbers and schedule numbers of piping.
   4. Type and pressure ratings of pipe fittings.
   5. Flow and pressure drop data on feedwater regulating valves.
   6. Technical data on water level control system.
   7. Scale ranges of gages, thermometers and pressure switches.
   8. Location of water level sensing and indicating device set points in relation to normal water line and lowest and highest permissible water levels of boiler.
   9. Set pressure and capacity of safety valves.

D. Burner and fuel valve and piping trains:
   1. Catalog data and drawings showing burner assembly and fuel train arrangement.
   2. Outline drawings of flue gas recirculation (fgr) ductwork (if applicable).
   3. Outline drawings of sound attenuators on forced draft fan intake or discharge.
   4. Drawings showing assembly of throat refractory into furnace.
   5. Type and temperature rating of throat refractory.

6. Drawings and catalog data on all equipment in igniter (pilot) train, main fuel trains, and atomizing media train. Include data on pressure and temperature ratings, flow versus pressure drop, performance characteristics. Include complete data on air compressors (for oil atomizing) with sound attenuators and motors.
7. ASTM numbers and schedule numbers on all piping.
8. Type and pressure ratings of pipe fittings.
9. Burner flow and pressure data:
    a. Main burner fuel and atomizing air pressures and flows at maximum required firing rate.
    b. Igniter (pilot) fuel flow and burner pressure.
    c. Natural gas main fuel pressure at inlet and outlet of main burner pressure regulator.
    d. Igniter (pilot) fuel pressures (natural gas and lp gas) at inlet and outlet of burner mounted pressure regulators.
    e. Forced draft fan static pressure, power and air flow at maximum firing rate.
10. Full load efficiency and power factor of all motors.
11. Predicted sound level at maximum firing rate on each main fuel.
12. Weight of burner assembly.

E. Boiler, burner, economizer predicted performance data:
1. At maximum required output: on each fuel at site altitude, with and without economizer (if applicable) in service, at 15 percent excess air. Data must include fuel and steam flow, boiler flue gas outlet temperature, economizer (if provided) flue gas outlet temperature, steam quality, boiler efficiency, windbox and furnace pressures, predicted boiler radiation and unaccounted losses, feedwater and flue gas pressure losses in the economizer (if provided).
2. At low fire, 25%, 50%, 75% of maximum required output. Excess air, CO ppm, NOX ppm on each fuel.

F. ASME “p” forms, manufacturer’s data report, on boiler and economizer construction – submit after boiler and economizer are fabricated.

G. Pretest data - boiler, burner, controls: as required by part 3.

H. Completed system readiness checklists provided by the commissioning agent and completed by the contractor, signed by a qualified technician and dated on the date of completion in accordance with the requirements of section 23 08 00 commissioning of HVAC systems.

1.5 PROJECT CONDITIONS

A. Fuels to be fired, main burner: natural gas

B. Igniter (pilot) fuels: natural gas.

C. Natural gas: high heating value is reported as 1040btu per cubic foot at gas company base pressure and temperature. Pressure provided to the inlet of the boiler-mounted regulators will be (2 psi gage as maintained by main regulator station.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. ASTM international (ASTM):
1. A106/A106M 08 standard specification for seamless carbon steel pipe for high temperature service.
2. A178/178M-02(2007)standard specification for electric-resistance-welded carbon steel and carbon-manganese steel boiler and superheater tubes
3. A269-10standard specification for seamless and austenitic welded stainless steel tubing for general service
4. C612-10standard specification for mineral fiber block and board thermal insulation
5. D396 09A standard specification for fuel oils

C. American society of mechanical engineers (ASME):
1. Boiler and pressure vessel code 2007 edition with amendments.
2. Section I power boilers
3. Section II material
4. Section VII recommended rules for care of power boilers
5. Section IX welding and brazing qualifications
6. Performance test code (ptc):
7. Ptc 4 2008 fired steam generators
8. Code for pressure piping:
9. B31.1-2007 power piping

D. National fire protection association (NFPANFPA):
1. 85-2007 boiler and combustion systems hazards code.

E. Underwriters laboratories (UL):
1. 50 2007 enclosures for electrical equipment.

F. Department of health and human services, food and drug administration (FDA):
1. CFR 21, 173.310, boiler water additives permitted in plants where steam contacts food.

G. Environmental Protection Agency (EPA):

H. CFR 40, part 60, appendix A, method 9, visual determination of the opacity of emissions from stationary sources.

PART 2 - PRODUCTS

2.1 BOILER

A. General boiler design

1. The boiler shall be a cleaver-brooks model cfh 700, single pass horizontal commercial firetube design or approved equal. It shall be mounted on a heavy-duty steel frame with premix forced draft burner and burner controls as a complete package from one manufacturer.
2. Approvals - the complete package including the burner shall be Underwriters Laboratories, inc. Listed and the official UL/CUL label shall be affixed to the package attesting to its certification.
3. If boiler is shipped as a preassembled package, the standard boiler shall be factory fire tested.
4. The complete package as shipped, shall be ready for connections to water, fuel, blowdown, and exhaust venting. Certain items may be shipped loose to prevent their damage such as the safety valves and gauges.

B. Boiler shell
1. The boiler shell must be constructed in accordance with the ASME code, either section i for high-pressure steam or section iv for low- pressure steam. The vessel must be subjected to the required inspections of the code conducted by an independent third party inspector. A signed inspection sheet shall be provided to the purchaser and the appropriate ASME symbol shall be affixed or stamped onto the boiler.
2. Boiler shall be mounted on base rails suitable for transporting by fork lift.
3. Burner housing shall be hinge-mounted to allow tube inspection.
4. Each carbon steel boiler tube shall utilize the alufer heat transfer design technology for high efficiency and reduction in overall size of the vessel and shall be a minimum of 0.105 tube wall thickness.
5. To facilitate waterside inspection, 3 hand holes shall be provided.
6. An observation port for flame inspection shall be provided.
7. Boiler insulation shall consist of 2-inch fiberglass blanket, which shall be covered with a powder coated sheet metal jacket. This jacket and insulation design shall permit field removal and reattachment if necessary for inspection, etc.
8. The entire boiler and base frame shall be factory painted.
9. Exhaust vent shall be located at the rear of the boiler and shall be a slip connection. Stack support shall be by means other than the boiler connection.
10. The following boiler vessel tappings/openings shall be furnished:
    a. Steam supply by npt connection for high-pressure steam or flanged for low pressure steam.
    b. Bottom blowdown.
    c. Feedwater make-up.
    d. Surface blowoff.
    e. Chemical feed.
    f. High water level overflow drain to discharge water in the boiler if water level reaches an unacceptable level.

C. Boiler trim
1. Conform to ASME boiler and pressure vessel code, section i and csd-1
2. A water column shall be furnished complete with gauge glass and water column blowdown valve.

a. Feedwater pump control - shall be integral with the water column via probe control device and electronics for on/off pump operation.
b. Low water cutoff - shall be integral with the water column via probe control device and solid state electronics mounted and wired in the control panel.

3. An auxiliary low water cutoff shall be provided. It shall be located on the top centerline of the boiler using an internal probe and shall be of the manual reset design.
4. For safety steam pressure lockout a high limit pressure control, manual reset shall be provided. The device shall be mercury free.
5. To provide steam demand tracking a steam pressure transmitter shall be provided that provides an input signal for burner positioning in accordance to steam demand.
6. A 3" steam pressure gauge shall be piped onto the trim piping, including an inspectors test cock.
7. In accordance with the a.s.m.e. Code an approved a.s.m.e. Rated and stamped safety valve shall be provided and set at 150#.
8. The factory installed package shall include an economizer coil located in the rear of the boiler, integral to the stack outlet with integral make-up water supply and outlet piping. A vertical stainless steel feedwater tank complete with a continuous running pump shall be provided with integral piping. This piping shall include the feedwater make-up stop valve, check valve, and on/off electric make up valve. The make-up valve shall be factory wired to the on/off pump control. Feedwater piping shall include by-pass piping so that water circulates through the economizer at all times.

D. Burner and burner controls

1. Mode of operation - to minimize short cycling and provide highest efficiency the burner for the specified boiler shall be of the electronic modulation with a turndown ratio of 5:1 for natural gas for sizes of 40 horsepower and greater, and 4:1 for sizes below 40 horsepower. On/off or low/ high burner operation shall not be accepted.
2. The burner shall be enclosed in a NEMA 1 type enclosure. A lift off top cover shall be provided to gain access to the burner and controls.
3. The burner design shall be of the linkage-less premix technology wherein the fuel and air are mixed in the fan housing assembly prior to entering the burner canister. Separately driven linkage or servo motor driven fuel and air valves shall not be permitted.
    a. Fan housing shall utilize non-sparking material and shall be approved for premix operation.
    b. The fan shall be driven by a variable speed motor which shall react to output demand requirements via the demand control motor shall be a high efficiency dc brushless type. Continuous speed synchronous motors will not be acceptable.
4. Ignition of the fuel shall be of the direct spark design; separate pilot gas train is not required. Dual ignition electrodes shall used for the spark generated from the panel mounted ignition transformer.
5. Combustion shall take place on the surface of the burner canister. The canister shall be constructed of fecralloy material and stainless steel and shall be warranted for five years against failure from defects or poor workmanship.
6. Air filter - shall be fitted to the intake air venturi to filter the incoming air supply when using boiler room air. The air filter shall be designed to be easily cleaned and re-used.
7. Fuel - the burner shall be designed for operation with natural gas or lp gas. Gas train, shall be located at the front of the burner and along the left side of the boiler. In

accordance with UL/CUL and ASME csd-1, the following components shall be furnished:

a. Single body dual solenoid safety shutoff valve incorporating the following:
   1) The valve shall be a 1:1 ratio valve with an integral trim regulator and shall operate in relation to the fan speed. An air sensing line shall be connected from the air inlet venturi (mounted to the fan motor) and to the gas valve for control of gas input.
   2) As fan speed increases a negative pressure will be applied to the valve, allowing the valve to open further, permitting more fuel to flow into the venturi for mixing. As fan speed is reduced, fuel input shall be reduced accordingly. Air shall always lead fuel from low to high or high to low.
b. Manual fuel shutoff valve - shall be located downstream of the gas valve and used for csd-1 leak testing.
c. Gas pressure interlocks - one shall be provided for sensing high gas pressure and one provided to sense low gas pressure. Each control shall be of the manual reset type.
d. Gas pressure regulator - shall be provided upstream of the gas valve to provide regulated pressure to the gas train from the gas supply. This regulator shall be suitable for a maximum of 1 psig gas pressure. If gas pressure exceeds 1 psig, a gas pressure relief valve shall be furnished and upstream pressure regulator that is of the full lockup type.
e. Manual shutoff valves - shall be provided upstream of the gas regulator to manually close off the gas supply when servicing the gas train or isolating the boiler. A shutoff valve shall be provided at the burner for tightness checking of the gas valve.
f. Combustion air proving switch shall be provided to prove, prior to modulation that the fan is operating properly.
g. Flame sensing shall be accomplished with a flame rod mounted in the burner mounting plate, designed for easy removal for inspection or replacement.

E. Control panel
   1. A NEMA 1 type enclosure is furnished and located at the front of the boiler to house the following components:
   2. The boiler shall include a computerized boiler burner control which shall be an integrated, solid state digital micro-processor modulating device, complete with sequence indication, fault reset, mode selection, and configurable parameter settings. It shall be mounted at the front of the boiler panel for easy access and viewing. The controller combines flame supervision, burner sequencing, modulating control, and operating limit control.
   3. Controller shall provide for both flame safeguard and boiler control and shall perform the following functions:
      a. Burner sequencing with safe start check, pre-purge, electronic direct spark ignition, and post purge. Flame rod to prove combustion.
      b. lame supervision. The control shall provide pre-purge and post- purge and shall maintain a running history of operating hours, number of cycles, and the most recent 15 faults. The control shall be connected to a touchscreen display interface that will retrieve this information.

c. Safety shutdown with display of error.
d. Modulating control of the variable speed fan for fuel/air input relative to load requirements.
e. Gas pressure supervision, high and low.
f. Combustion air proving supervision.
g. High air pressure (back draft too high) supervision.
h. The active steam pressure and set-point pressure shall be displayed at all times. Output shall be modulating pid set point control via analog signal.
i. Controller shall be capable of Modbus communication to interface with pc or building energy management system.

4. All parameter input control set-points shall be factory pre-configured with jobsite conditions programmed at the time of initial operation.
5. Demand switch.
6. Provide terminals for control interface wiring, customer connections, and connections for incoming power.
7. Install solid state circuit boards for water level controls.
8. Alarm light package to provide indication of low water, flame failure, load demand, fuel valve on, including a horn with silencing for alarm conditions.

F. Performance and emissions:
1. Fuel to steam efficiency shall be guaranteed at 85% with flue gas economizer. Efficiency rating shall account for radiation and convection losses.
2. Nox emissions shall be less than 20 ppm corrected to 3% o2 and less than 10 ppm co over the operating range of the burner turndown. If emissions exceed this level, the boiler manufacturer shall correct at their expense until this level is achieved on a repeatable basis.
3. Noise - sound shall not exceed 70 dba at high fire when measured 3 feet in front of the burner.
4. Radiation losses shall be less than 0.5% of the rated input at maximum firing.
5. Steam quality shall be 99.5% at maximum firing regardless of operating pressure.

2.2 BOILER RETURN SYSTEM

A. Components
1. Boiler Feed Receiver
a. Receiver shall be vertical welded 304 Stainless Steel
b. Head and shell thickness shall be 12 gauge
c. Receiver shall have a networking capacity of not less than that shown on the schedule
d. Receiver shall have an inlet, vent, overflow, drain
e. Receiver shall be furnished with:
1) Gauge Glass Assembly with SS Valves, High Pressure Gauge Glass and Heavy Duty SS Glass Guards
2) Bi-Metal Thermometer
3) Stainless Steel Suction Piping including SS Isolation Valves and SS Suction Strainer

4) Provision for steam preheat – stainless steel steam sparge tube or noiseless educator and feed tank temperature control (optional)
5) Receiver shall have a 20 year warranty against corrosion.

2. Pump(s)
   a. Boiler Feed water pump(s) shall be vertical multi-stage centrifugal pumps with all-wetted components constructed of stainless steel.
   b. Pump capacities and electrical characteristics shall be as shown on the schedule.
   c. Each pump shall be sized for a minimum of 2 times the boiler evaporation rate.
   d. Each pump shall be close coupled to a 3450 RPM C-Face TEFC motor
   e. Mechanical shaft seal shall be rated for 250 degrees F continuous operation
   f. Pump shall have a 5-year warranty against corrosion of the SS components
3. Water make-up assembly
   a. The water make-up assembly shall consist of a float switch mounted at the water make-up level in the tank. A control system will electronically activate a solenoid valve to add softened make-up water to the tank.
   b. A non-siphon filler well (air gap assembly) shall be provided.
4. Control Panel
   a. The control panel shall include a NEMA 1 Steel Enclosure
   b. Motor Starters
   c. Class 10 Solid State Overloads
   d. Pump Circuit Breakers
   e. HOA Selector Switches
   f. Pump Run Indicator Lights
   g. Designed to receive pilot signal from boiler(s)
   h. UL 508 Labeled

2.3 BLOWDOWN SEPARATOR

A. Furnish and install as shown on plans:
   1. Boiler Blow-Down Separator for use with an intermittent bottom blowdown valve.
   2. The separator is to be welded carbon Steel Vessel Designed and "UM" Stamped to ASME Code for 250 psig @ 450 Deg. F. Plate Thickness 5/16”
   3. Connections are threaded type and include a tangential inlet with stainless steel striking plate at point of impingement, a centrally located steam vent for clean quite release of steam to atmosphere, and bottom drain fitted with a stainless steel spiral baffle.
   4. Furnish and install W/3 Angle Legs for Floor Mounting.
   5. Furnish and install as shown on plans for Automatic Control of Drain Water Temperature to 140 Deg. F. A Automatic Aftercooler, a Temperature Regulator Valve sized for cooling water at 50 psig., Strainer, and 2" Dial Bimetal Thermometer.

B. Chemical Treatment system
   1. Chemical Addition Tank
      a. Chemical addition tank shall be a package consisting of chemical metering pump, chemical mix/storage tank, agitator, control panel and accessories as required. The package shall be hydraulically and electrically tested at the factory and shall be preassembled to the fullest extent possible. The package shall be furnished

complete with the required lubricants and installation instructions. Materials of construction are to be specified by the chemical supplier or design engineer.

2. Pump
   a. Solenoid type pump will offer adjustable, manual control from adjustable stroke length, 0-100% throughout the rated capacity of the pump.
   b. Pump shall have circuit protection against voltage and current upsets. Solenoid will be protected against thermal overload with auto-reset.
   c. The pump must be Water Resistant, acceptable for outdoor and indoor applications.
   d. The pump must have ball guided ball check Valve systems to prevent back flow and enhance outstanding priming characteristics.
   e. The liquid end of the pump and the injection quill must be made of PVDF=Polyvinylidene Fluoride.
   f. The balls in ball check design must be made of ceramic material.
   g. Injection nozzles must be capable of handling temperatures of up to 250°F.
   h. Pumps must be equipped with durable leak-free bleed valve assembly to insure safe and easy priming.
3. Tank
   a. Tank must meet or exceed secondary containment regulations set under EPA 49CFR.
   b. Tank must be square and natural colored.
   c. Tank must be designed with pump mounting surface, female threaded connections and twist lid inspection port.
   d. Tank must be constructed of Low Density Polyethylene.
   e. Tank capacity to be determined by the design engineer or chemical supplier.
   f. Standard tank size is 20 gallons, tank – 18” w x 18”l x 24”t.

C. Water Softener
1. The tanks shall be designed for a working pressure of 150 psi, hydrostatically tested at 50% in excess and rated at burst of four (4) times working pressure. A minimum freeboard volume of 50% shall be provided to assure adequate bed expansion during backwash. Tanks shall be manufactured of durable composite resin and reinforced with high-tensile strength filament windings. Tanks are resistant to corrosion, providing years of reliable service. Thermoplastic liners shall be made of high strength polyethylene. A molded plastic base supports the fiberglass tanks. Tanks shall be tested and certified by NSF. Including the base, each vessel shall have nominal dimensions of 9 inches diameter x 48 inches height.
2. Main Control Valve
   a. The control valve shall have 1 inch NPT inlet and outlet connections. It shall be a low lead brass mechanically-actuated, hydraulically balanced, self-cleaning piston six-position type to accomplish the regeneration steps of backwash, brine draw, slow rinse, fast rinse, and refill. Separate rinse and timed refill positions will be provided to reduce regeneration water use. The valve shall contain fixed orifice eductor nozzle and self-adjusting backwash flow control. The bypass body, like the main control valve, shall be actuated by a mechanical drive when used. The valve will be capable of being manually stepped through regeneration without electrical

power. The valve body will be constructed of low lead brass meeting the requirements of NSF 61.

3. Distribution System
   a. The soft water collector and backwash water distributor shall be a single point fine-slotted self-cleaning plastic manifolds with slots no larger than 0.010-inch width.
4. Brine System
   a. 2.4.2.4.1.A combination salt storage tank with cover and brine tank well shall be supplied as part of the system. The tank shall be sufficient size to hold salt for at least 65 regenerations between refills. The tank(s) shall be made of corrosion-free one-piece molded polyethylene or fiberglass reinforced plastic material. The tank(s) shall have a nominal diameter of 18 inches and a height of 40 inches.
5. Ion Exchange Resin and Underbredding
   a. Each softener tank shall be provided with 1.0 cubic feet of high capacity synthetic ion exchange resin having a minimum exchange capacity of 30,000 grains per cubic foot when regenerated with 15 pounds of salt per cubic foot. The resin shall be solid, with uniform particle size, clean and free of dirt and extraneous matter that might interfere with flow of water through the resin or that might interfere with the ion exchange process.
   b. The resin will rest on a bed of quartz at least two inches in depth above the distributor. The quartz shall be washed and dried to remove the debris and fines, and screened not to exceed 16 mesh size by 3/16-inch particle size.
6. Electronic Demand – Twin Alternating
   a. This computer based demand, meter initiated controller operates system from 1 to 2 units in single, parallel or alternating operating configurations. The control will utilize alphanumeric, self-prompting programming for simple start up. EEPROM memory shall store program data eliminating need for battery back-up or configuration input after power loss. It is pre-wired and includes twist lock electrical end connectors for installation ease.
   b. The controller will constantly monitor current operating condition and be capable of displaying instantaneous flow rate through the system. A resettable totalizing flow counter will be included to measure total water processed.
   c. The control shall be self-diagnostic and capable of emitting an audible signal and error specific messages if it detects a system problem. Valve and control operation will be 24V, 60Hz, 1ph A suitably sized UL/CSA listed transformer(s) will be provided to convert 120V, 60Hz, 1ph power for system operation. Control printed wiring assemblies will be conformably coated to MIL specifications suitable for use in humid environments. A watertight enclosure will be used to house the control.
   d. This duplex meter initiated system has one unit(s) on line, and a companion in standby, or regeneration. Regeneration is immediate based a batch count. The standby unit moves to line position. Built in interlock does not allow more than one unit to be in regeneration at a time.
7. Flow Sensors
   a. A turbo flow sensor which is a solid state proximity transducer with a self-lubricated riding on a sapphire bearing. The sensor shall be made with no packing glands or rotating shaft seals. The sensor shall be made in such a way that it can

be installed and removed with simple hand tools. Pipe size of the sensors shall be 1 inches. It shall have a minimum flow of 1 gpm, and a peak flow of 50 gpm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to section 23 05 11, common work results for HVAC and steam generation.

B. Boiler and burner access openings: arrange all equipment and piping to allow access to openings without disassembly of equipment or piping. Provide space that permits full opening of all boiler and burner doors, panels and other access openings. Provide space for pulling full length of all boiler tubes directly from their installed location.

C. Drainage facilities for boiler water column, gage glass, low water cutoffs, water level alarms:
   1. Locate and orient sight flow indicators so that one person can view the fluid flow while simultaneously operating drain valves and low water cutoff shunt switches.

D. Boiler flue gas outlet location: drawings show a location based on an assumption on the number of passes of the boilers. If the boilers submitted have a different flue gas outlet location, redesign and relocate the stack and breeching systems, at no additional cost to the government.

E. Boiler casing flashing: flash or seal all openings in the casing at the top of the boiler at the piping and the flue penetrations to prevent leakage of water into the boiler insulation.

3.2 CLEANING AND PROTECTION FROM CORROSION

A. Refer to section 23 05 11, common work results for HVAC and steam generation.

B. Boiler cleaning:
   1. Upon completion of installation, the initial firing of the burner shall be performed to boil out, under supervision of boiler manufacturer, all internal surfaces with chemical solution recommended by boiler manufacturer, to remove all mill scale, corrosion products and other foreign material. Following boil out, boiler shall be washed and flushed until water leaving the boiler is clear. Drain boiler, inspect internal surfaces for cleanliness, then refill boiler with softened and treated water.
   2. Refer to the article inspections and tests for requirements for cleaning boiler after operational tests are completed.

C. Protection from corrosion:
   1. Protect the boilers from fire side and water side corrosion at all times.
   2. Dry storage: when the boilers are not filled with water, protect the water sides and fire sides with a dry storage method recommended by either the boiler manufacturer or the ASME code, section vii.

3. Wet storage: if, after water is placed in the boilers, they are not fired for equipment adjustment or testing for more than two weeks, the boilers shall be protected with a wet storage method recommended either by the boiler manufacturer or the ASME code, section vii.
4. Chemical treatment: the quality of the water in the boilers shall be maintained by a professional water treatment organization. This organization shall provide on site supervision to maintain the required water quality during periods of boiler storage, operating, standby and test conditions. Furnish monthly reports by the water treatment organization, to the resident engineer (re). The contractor shall provide all chemicals, labor and professional services until the government has accepted the boilers for operation. All chemicals utilized must conform to FDAguidelines applicable for steam used in food preparation.

3.3 INSPECTIONS AND TESTS

1. The following tests and demonstrations must be witnessed by the resident engineer (re) or his/her representative, and must prove that boilers, economizers, burners, controls, instruments, and accessories comply with requirements. Refer to section 23 08 11, demonstrations and tests for boiler plant for general requirements. When test results are not acceptable, make corrections and repeat tests at no additional cost to the government. Pretests do not require the presence of the re.
2. Condition of boiler and economizer after delivery, rigging, placement: after setting boiler on foundation and placing economizer on supports, and prior to making any connections to boiler and economizer, the contractor and re shall jointly inspect interior and exterior for damage. Correct all damage by repair or replacement to achieve a like new condition.
3. Hydrostatic tests:
    a. Boiler, economizer: contractor shall provide inspector certified by national board of boiler and pressure vessel inspectors to conduct tests after equipment is installed and connected for operation and prior to initial firing. Test pressure shall be 1 1/2 times the design pressure of the boiler for a period required by the inspector. Provide written certification of the satisfactory test, signed by the inspector. Correct any deficiencies discovered during the testing, and retest equipment until satisfactory results are achieved and are accepted by the inspector.
    b. Boiler external piping (as defined by ASME B31.1, power piping):
    c. Refer to section 23 21 11, boiler plant piping systems.
    d. Test may be conducted concurrently with boiler and economizer testing.
4. Identify and remove any connecting equipment which is not rated for the test pressure. Cap the openings left by the disconnected equipment. Reinstall the equipment after tests are completed.

B. Boiler steam safety valves:

1. Test each valve set pressure and blowdown pressure with boiler steam pressure. Perform accumulation test by operating burner at high fire to verify that safety valve flow capacity is sufficient to handle the maximum boiler steaming rate. Tests shall be performed with boiler isolated from the main steam header and all generated steam exhausting through the safety valves.

2. Valve popping tolerance: plus or minus three percent of set pressure for set pressures over 480 kpa (70 psi) gage.
3. Valve blowdown tolerance: reset at not less than 6 percent below set pressure of valve with the lowest set pressure. Minimum blowdown two percent of the set pressure.
4. Accumulation test: with burner at high fire, the boiler pressure shall not rise more than six percent above the set pressure of the safety valve with highest pressure setting and shall remain below the maximum allowable working pressure of the boiler.

C. Burner control system:
1. Demonstrate operation of all control, interlock and indicating functions. Refer to section 23 09 11, instrumentation and control for boiler plant.
2. Prior to scheduling final test submit certification that all control, indicating, and interlock functions have been pretested.
3. Conduct final test immediately prior to boiler burner tests.
4. Experienced personnel representing the manufacturer of the system shall conduct the tests.

D. Performance testing of boiler, burner, economizer, combustion control, boiler plant instrumentation:
1. Perform tests on each boiler on all main burner fuels.
2. If required by local emissions authorities, provide services of testing firm to determine nox and carbon monoxide. Test firm shall be acceptable to emissions authorities.
3. Test no. P 1:
    a. Operate boiler on each fuel, with economizer in service and record data for at least six evenly spaced steam loads from low fire start to 100% of full steam output, and in the same sequence back to low fire. Demonstrate performance and efficiency required by paragraphs under articles, boiler, burner and fuel trains, and economizer and by boiler and economizer equipment lists on drawings.
    b. Demonstrate proper operation of combustion controls, draft control (if provided), feedwater level controls, and instrumentation systems (refer to section 23 09 11, instrumentation and control for boiler plant.
    c. When flue gas oxygen trim is provided, conduct tests with trim control on manual at the zero trim (null) position. Refer to section 23 09 11, instrumentation and control for boiler plant. After completion of tests with trim control on manual control, repeat the tests on one fuel with the trim control on automatic control.
4. Test no. P 2:
    a. Demonstrate sound level of fans and burner systems and atomizing air compressor.
    b. Test point shall be at 100 percent of maximum boiler load.
    c. Refer to sound level requirements in section 23 05 51, noise and vibration control for boiler plant.
5. Test no. P 3:
    a. Check current draw of forced draft fan motor at prepurge and at 100 percent of maximum boiler load.
    b. Current draw shall not exceed full load current stamped on motor nameplate.
    c. This test may be combined with test no. P 1.
6. Test methods:

a. Utilize permanent instrumentation systems for data. All systems shall be operable and in calibration.
b. Utilize portable thermocouple pyrometer furnished and retained by contractor to measure stack temperature as a verification of permanent stack temperature recorder.
c. Use portable electronic flue gas analyzer to determine constituents of flue gas. Analyzer shall be capable of measuring oxygen in per cent with accuracy of plus or minus 0.5 percent oxygen and carbon monoxide in parts per million (ppm) with accuracy of plus or minus 5 percent of reading (range 0 l000 ppm). Obtain oxygen and carbon monoxide readings at each test point. Calibrate instrument with certified test gases within three months prior to use and immediately after analyzer cell replacement.
d. In test no. P 1 retain boiler at each load point for a time period sufficient to permit stabilization of flue gas temperature and other parameters.
e. Steam loads for tests may be furnished by the hospital systems, by operation of the steam silencer vent system, or by a combination of the above. If variable hospital loads interfere with testing, conduct tests at night or on weekends when loads are more stable.
f. Utilize dry bulb and wet bulb thermometers furnished and retained by contractor for checking combustion air.
g. Smoke testing shall be by visual observation of the stack and by smoke density monitor (permanent instrument - if provided). If smoke density monitor is not provided, utilize bacharach model 21-7006 smoke test kit. If there is disagreement with the results of these tests, provide qualified observation person and tests in compliance with EPA reference method 9 (cfr 40, part 60, appendix a).
h. Sound level instruments will be government furnished.
i. Nox emissions shall be tested with electronic analyzer reading in parts per million. Analyzer shall be calibrated with certified test gas within three months prior to use. Analyzer shall be accurate to plus or minus 5% of reading.
    1) 3.3.6.6.9.1.1.An additional efficiency test will be required, conforming to ASME performance test code ptc 4, if the boiler efficiency determined in the test p-1 above, does not comply with requirements. Utilize ASME test forms ptc 4.1.a, 4.1.b, and the abbreviated input-output and heat balance methods.

7. Pretesting:
    a. Perform pretest at the final stage of the burner fine tuning process.
    b. Prior to scheduling final test, submit evidence of pretest. Evidence shall consist of start-up data sheets signed and dated by personnel representing burner manufacturer, combustion controls manufacturer, burner controls manufacturer.
    c. Pretest data sheets shall list the following data for each fuel and at each fuel valve controller position, starting at minimum position, proceeding to the maximum position and returning to the minimum position.
        1) Fuel flow and air flow controller position.
        2) Fuel pressures: at burner and also upstream of fuel flow control valve.
        3) Fuel flow rate.
        4) Boiler feed pressure, upstream of feedwater regulator (at minimum, 50 percent, maximum firing positions only).

5) Boiler feed temperature (at minimum, 50 percent, maximum firing positions only.
6) Stack temperature: boiler outlet, economizer (if provided) outlet.
7) Flue gas oxygen and carbon monoxide (utilize flue gas analyzer which has been calibrated with certified test gases).
8) Steam flow rate (at minimum, 50 percent, maximum firing position only).
9) Steam pressure boiler, header (at minimum, 50 percent, maximum positions only).
10) Opacity of flue gas.
11) Flue gas nox (if limit specified).
12) Combustion air temperature dry bulb and wet bulb.
13) Barometric pressure (one reading).

E. Internal inspection of pressure parts and furnace:
1. After all operational tests are satisfactorily completed, a government retained, licensed boiler inspector will determine if the boiler is free from corrosion, deposits, and any other type of damage or defect.
2. In preparation for the inspection, open all manways, handholes, and access doors or panels at the ends of the boiler. Drain and clean the interior of all pressure parts and clean all soot and debris from furnace and fire tubes.
3. Any corrosion, damage or defect shall be corrected to a like new condition in the judgment of the boiler inspector.
4. After the boiler inspector has approved the boiler, all manways, handholes, and the access doors shall be closed with new gaskets.

F. If burner operation results in deposits of carbonaceous materials in the furnace or tubes clean the furnace and tubes, modify the burners as necessary, and retest the burner performance.

3.4 STARTUP AND TESTING

A. The commissioning agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the resident engineer and commissioning agent. Provide a minimum of 7 days prior notice.

3.5 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of section 23 08 00 –Commissioning of HVAC Systems for all inspection, start up, and contractor testing required above and required by the system readiness checklist provided by the commissioning agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 23 08 00 – Commissioning of HVAC Systems and related sections for contractor responsibilities for system commissioning.

3.6 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct each HVAC personnel responsible in the operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of section 23 08 00 – Commissioning of HVAC Systems.

END OF SECTION 235239

SECTION 23 5700 - HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes shell-and-tube and plate heat exchangers.

B. Related Sections include the following:

1. Division 23 Section "Seismic Restraint For HVAC Piping and Equipment" for requirements necessary for compliance with seismic criteria

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Tube-removal space.
2. Structural members to which heat exchangers will be attached.

A. Seismic Qualification: Manufacturer’s certification of seismic qualification according to ASCE 7-05. Submit ASCE 7-05 special seismic certification as required. Include method used to determine compliance with requirements.

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements

B. Product Certificates: For each type of shell-and-tube heat exchanger. Documentation that shell-and-tube heat exchangers comply with "TEMA Standards."

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals

1.6 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, performance, and dimensional requirements of heat exchangers and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."

B. ASME Compliance: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

C. Registration: Fabricate and label shell-and-tube heat exchangers to comply with the Tubular Exchanger Manufacturers Association's standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHELL-AND-TUBE HEAT EXCHANGERS

A. Manufacturers:

1. Alfa Laval
2. API Heat Transfer Inc.
3. Armstrong Pumps, Inc.
4. ITT Industries; Bell & Gossett.
5. Taco, Inc.
6. Thrush Company, Inc.

B. Configuration: Straight tube with removable bundle.

C. Shell Materials: Steel .

D. Head:

1. Materials: Carbon steel.
2. Flanged and bolted to shell.

E. Tube:

1. Seamless copper tubes.
2. Tube diameter is determined by manufacturer based on service.

F. Tubesheet Materials: Type 316 S.S.T.

G. Baffles: Brass.

H. Piping Connections:

1. Shell: Flanged inlet and outlet fluid connections, threaded drain, and vent connections.
2. Head: Flanged inlet and outlet fluid connections.

I. Support Saddles:

1. Fabricated of material similar to shell.
2. Foot mount with provision for anchoring to support.

2.3 Stainless Steel Plate Heat Exchangers

A. Design
1. Preference should be given to single pass designs with all connections located on the frame plate (fixed head) to allow for removal of plates and inspection without dismantling the process piping.
2. For single pass units, all connections should be located on the frame plate (fixed head), allowing the pressure plate (movable head) to slide back and have plates added, removed, or replaced from the plate pack without disturbing the connections or associated piping.
3. The design should allow for the removal of any plate in the plate pack without requiring the removal of any other plates.
4. The unit shall be provided with a stainless steel splash shield covering the sides and top of the plate pack. The bottom should be left open for leak detection.
5. The unit shall be designed, tested, and U stamped in accordance with ASME Section VIII Division 1 and registered with the National Board. A U-1 data report to be furnished upon request.
6. Manufacturer must be certified and registered with ISO 9001:2008. A certificate of registration shall be supplied upon request.
7. Unit must be factory pressure tested with ASME U stamp applied on nameplate prior to leaving the factory.

B. Frame

1. The frame and pressure plates shall be carbon steel SA 516 grade 70.
2. The frame and pressure plates shall be of sufficient thickness to meet the ASME design pressure without the use of stiffeners or other type of reinforcement.
3. Carbon steel frame components, except hardware, shall be painted with gray macro epoxy paint to a minimum of 4 mils dry film thickness.
4. Carbon steel frame and pressure plates shall be steel grit blasted to SSPC-SP6/NACE 3 (Commercial Blast Cleaning) with surface profile of 2 mils on either face. All surfaces and openings must have a recoatable epoxy primer applied within 8 hours of blast or before flash rusting occurs.
5. Frame plates shall have integral lifting eyes in the upper corners. Bolted or welded on lifting lugs not allowed.
6. Units with studded port connections shall have unlined or alloy lined studded ports to mate with a raised face or flat faced ANSI flange where 150# ANSI flanges are acceptable. Rubber liners are not allowed.
7. Units with NPT connections, except 1" port sizes, shall have the frame plate tapped with carbon steel female NPT connections or, if alloy material is required, extended male NPT nozzles.
8. Units with 1" ports shall have carbon steel or 316 stainless steel female tapped NPT or alloy material male NPT connections.
9. For units with studded port type connections, the studs around the ports must be provided by the manufacturer.
10. Units with connections greater than 3" require that the thermal plates be supported by the top carry bar. The bottom guide bar shall only assist in properly aligning the plates.
11. The design for units with 2.5" connections or smaller shall allow the plates to be supported by the bottom guide bar and the top carry bar shall help properly align the plates.
12. The carry and guide bar for 2" port models shall be carbon steel. For models with 2.5" ports and greater, the thermal plate contact surfaces of the carry and guide bar shall be carbon steel. For units with 1" connections, the carry and guide bars shall be zinc plated carbon steel. Provide any rust coating for carbon steel guides
13. For ease of movement during assembly and maintenance, the movable pressure plate shall be supported by a roller assembly over the carry bar for 4" ported models greater than 90" in height and for all 6" and larger ported models. For 4" ported models less than 90" in height, a glide clip made of ultra high molecular weight polyethylene shall be used on the movable pressure plate.
14. Units shall a minimum of two mounting feet at the frame plate and one at the support column, if a support column is used in the design.
15. For units with 300 psig design pressure or less, excluding "wide gap" designs, frames must be designed to withstand full test pressure in one circuit with zero pressure in the opposite circuit.
16. The nominal connection size shall match the nominal thermal plate port hole diameter.

C. Hardware
1. All bolting, including tightening bolts, shall be carbon steel SA193 grade B7 and galvanized via electroplating of zinc coating.
2. All nuts shall be carbon steel SA194 grade 2H and galvanized via electroplating of zinc coating.
3. Mounting feet shall be zinc plated carbon steel.
4. The tightening bolt assemblies on units with 3" and greater connections shall include lock washers at the movable pressure plate such that the unit can be opened and closed with one wrench from the front of the unit.

5. All the tightening bolt assemblies on units with 3" and greater connections shall include bearing washers at the fixed frame plate to reduce friction. Bearing assemblies only on some of the bolts is not allowed.
6. The nuts on the tightening bolt assemblies on units with 3" and greater connections shall be peened on, not welded, at the frame plate.

D. Plates
1. Plates shall be pressed in a one-step stamping process, except for plates 132" and greater in length, where multi step pressing is allowed.
2. Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate and carry bar and guide bar. Welded on hanging brackets or stiffeners are not acceptable.
3. The plate pack shall use a positive plate to plate alignment system to ensure proper plate to gasket seals throughout the plate pack. The positive alignment system shall either be a gasket lug which fits within a plate recess on the proceeding plate (tongue in groove) to align successive plates or an extended rolled edge hanger which nests successive plates through direct contact around the entire plate hanger. Plate designs which only offer alignment through contact with the carry and guide bar are unacceptable.
4. Plates shall have an enclosing groove for the entire gasket designed to contain the gasket while allowing for thermal expansion.
5. Plates shall be permanently marked to indicate plate material and thickness.
6. Double wall plates shall have an air gap with a leak detection path.
7. Stainless steel double wall plates shall be pressed at the same time to ensure a close fit with minimal loss of heat transfer.
8. For units with 300 psig design pressure or less, excluding "wide gap" designs, thermal plates must be designed to withstand full test pressure in one circuit with zero pressure in the opposite circuit.

E. Gaskets
1. All gaskets for single pass designs, except the gasket on the first plate, shall be identical.
2. The gaskets shall be a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination.
3. Gaskets shall have tapered sides to assure positive seating of the compressed gasket and assist in aligning the thermal plates during compression.
4. When available, glue-free gaskets are preferred to glued-on gaskets. Glue-free gasket attachment methods which break during gasket removal or plate maintenance, thus destroying the gasket, are not allowed.
5. Care should be taken in the selection of gasket materials to insure compatibility with the fluids and operating temperatures.

F. Thermal/Hydraulic Design and Certification
1. The manufacturer shall provide written guarantee to the accuracy of the heat exchanger thermal design.
2. The manufacturer shall be certified with the Air-Conditioning, Heating and Refrigeration Institute's Liquid to Liquid Heat Exchanger Certification program, AHRI Standard 400, for the Model being supplied.
    a. For units within the scope of the program: "This heat exchanger is certified by the AHRI Liquid to Liquid heat exchanger certification program based on AHRI Standard 400. AHRI certified units are subject to rigorous testing, have

performance ratings independently measured and are third party verified. Certified units may be found in the AHRI Directory at www.ahridirectory.org".

b. For units at operating conditions outside the scope of the program: "The operating conditions are outside of the scope of AHRI Standard 400 Liquid to Liquid certification program of 2000 gpm and/or 24,000,000 btu/hr. Model is an AHRI Standard 400 certified model"

3. In accordance with AHRI Standard 400, the manufacturers output/specification sheet shall have the following information:
   a. Model Number;
   b. Volumetric Flow Rate;
   c. Inlet Temperatures on Both Circuits;
   d. Outlet Temperatures on Both Circuits;
   e. Pressure Drops on Both Circuits;
   f. Surface Margin (also known as Excess Surface Area);
   g. Heat Duty (also known as Heat Load);
   h. Overall Heat Transfer Coefficient;
   i. Heat Transfer Area;
   j. Number of Plates;
   k. Channel Arrangements on Both Circuits;
   l. Number of Passes;
   m. Plate Material and Thickness;
4. Should the Heat Exchanger not perform to the specified conditions as defined in AHRI Standard 400, the manufacturer is responsible to replace or repair the exchanger to achieve the stated performance.
5. If the manufacturer is not certified with the Air-Conditioning, Heating and Refrigeration Institute's Liquid to Liquid Heat Exchanger certification program, AHRI Standard 400, a witnessed factory performance test must be completed per the testing specification of AHRI Standard 400.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HEAT-EXCHANGER INSTALLATION

A. Install shell-and-tube heat exchangers on saddle supports and concrete base. Provide structural steel framework as indicated on the Drawings and as required to adequately support the unit[**s**].

B. Install plate exchangers on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

C. Comply with mounting and anchoring requirements for seismic installations.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Maintain manufacturer's recommended clearances for service and maintenance. Install piping connections to allow service and maintenance of heat exchangers.

C. Install shutoff valves at heat-exchanger inlet and outlet connections.

D. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.

E. Install vacuum breaker at heat-exchanger steam inlet connection.

F. Install hose end drain valve to drain shell.

3.4 FIELD QUALITY CONTROL

A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION 23 5700

SECTION 23 7513 – CUSTOM AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes custom air-handling units with coils for outdoor installations. Built-up air handling units shall comply with this section.

B. Related Sections include the following:

1. Division 23 Section “Variable Frequency Drives” for variable frequency drive.
2. Division 23 Section “Motors for HVAC” for motors.
3. Division 23 Section “Mechanical Vibration and Seismic Controls for HVAC” for vibration control.
4. Division 23 Section “Air Duct Accessories” for dampers and sound attenuators.
5. Division 23 Section “Particulate Air Filtration” for filters and filter racks.
6. Division 23 Section “Instrumentation and Controls” for controls.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Air handling units shall withstand 8-inches of water column or 1.5 times the fan total static pressure without failure due to defective manufacture, fabrication, installation, or other defects in construction. Air handling units shall remain watertight and airtight after installation.

B. Cooling coils: Comply with performance requirements specified, as determined by testing assemblies representing those indicated for this Project.

1. Maximum coil face velocity shall be less than 400 feet per minute at maximum design airflow.
2. Maximum coil rows: 8
3. Maximum coil fins per inch shall be 9 fpi.
4. Minimum coil water temperature differential shall be 20°F.

C. Fan: Comply with performance requirements specified, as determined by testing assemblies representing those indicated for this Project.

1. Select fan operating point to the right hand side of peak static pressure point and near the peak of static efficiency.
2. Operation of the fan above 60 hertz is acceptable during the 90 to 100% maximum airflow range.
3. Fans shall be direct drive.

D. Comply with performance requirements specified, as determined by testing assemblies representing those indicated for this Project.

1.3 SUBMITTALS

A. Product Data: For each type of air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated, for present and future conditions and/or multi-rating table. Include dirty filter loading in static pressure calculation.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, efficiency and motor and fan accessories.
5. Material gages and finishes for base, panel walls, doors, floor, drain pan, hoods, and exterior hardware.

6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.
8. Itemized list of specified and unspecified internal AHU pressure losses at present and future conditions. Determine total fan static pressure, including external static pressure.
9. Certified air handling unit sound power level ratings in each octave band, for radiated and transmission sound for the fan and at the air handler casing inlet and outlet connections.
10. Acoustic panel, and insulation sound and thermal performance characteristics.
11.
12. Connection data: flexible duct connectors, piping and power connection.
13. Provide detail of mounting, securing, and flashing of roof curb to roof structure. Indicate coordination requirements with roofing system.

B. Shop Drawings: Signed and sealed by a qualified and registered California professional engineer.

1. Certified plan and elevation drawings indicating dimensions, weights, configuration, equipment locations, doors, door swings, duct size and connection location, and maintenance access requirements.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room layout and relationships between components, maintenance access requirements and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field Quality-Control Test Reports: From manufacturer.

E. Factory Test Results: From manufacturer.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain air-handling units through one source from a single manufacturer. Companies specified specialize in manufacturing of industrial quality, custom-design air handling units with minimum five years documented experience of the size and type to be provided on this project.

B. Product Options: Drawings and schedules indicate size, profiles, performance requirements, and dimensional requirements of air-handling units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements." Ensure that product meets project performance requirements and space allocation requirements, and that components are compatibly matched.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University, and marked for intended use.

D. Comply with California Electrical Code. (NFPA 70).

E. Galvanized steel sheets shall be hot dipped conforming to ASTM A653 and shall provide 0.90 ounces of zinc per square foot (G90).

F. Aluminum sheeting shall be aluminum alloy 3003-H14, conforming to ASTM B209, with thickness of 0.040" and hardness of Brinell 40.

G. Aluminum structural base shall be aluminum alloy 6061-T6, conforming to ASTM B308, with hardness of Brinell 73.

H. Aluminum extrusions for door frames, damper frames, and other frames shall be aluminum alloy 6063-T6, conforming to ASTM B221, with hardness of Brinell 73.

I. Unit shall have the approval of one of the following agencies: Underwriters' Laboratories (UL), Electrical Testing Laboratories (ETL) or Canadian Standards Association (CSA). The air handler shall bear an appropriate label certifying that the unit has been designed and manufactured in strict accordance with the UL1995 Standard for air handling equipment. If the manufacturer cannot provide an ETL/UL sticker on the air handler, it will be the sole responsibility of the contractor to arrange for local ETL or UL approval and labeling.

J. The Unit Electrical Panel(s) shall be built in strict accordance to NEC Standards.

K. AHU Controls Compliance: The air handling unit controls shall conform to UL 508 Industrial Controls Equipment.

L. National Fire Protection Association (NFPA): Air handling unit internal insulation, and supplementary materials, shall have a flame spread rating of less than 25 and smoke developed rating less than 50 complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

M. Certification: Fans shall have sound and air rating based on testing performed in compliance with the latest version of AMCA bulletins 210, 211, and 300.

O. P. Vibration Testing:

1. Sound and vibration testing to be performed by balancing contractor. The values will be checked with the levels being measured in mils peak to peak. Issue report for MEOR for evaluation.

2. During balancing, the fan shall be imposed with an operating resistance equal to the design external static pressure.
3. A certificate of compliance signed by the manufacturers Quality Control Inspector shall be attached to each fan assembly at the factory and incorporated into the operating and maintenance manuals.

Q. Approval: The University may witness testing. Provide a minimum two-week notification prior to proposed scheduled test. Failure of AHU to meet test requirements shall require correction of deficiency and re-testing of unit. Submit written results of factory tests to the University's Representative for approval prior to shipping of equipment.

R. Safety: AHU and components shall meet requirements of UL 1995 safety standard for "Heating and Cooling Equipment".

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

C. Coordinate size and location of structural-steel support members.

D. Coordinate electrical, temperature controls, and fire alarm system connection requirements. Controls may be factory mounted in lieu of field installation and is preferred by the University. Controls contractor to check prior to shipment.

E. Coordinate and provide the University's equipment access requirements. Include clearance for inspection, repair, component replacement, and maintenance service access.

F. Coordinate with the electrical contractor to provide factory installed conduit openings in the air handling unit casing.

1.6 DELIVERY, STORAGE AND HANDLING

A. Vacuum clean inside of the unit and wipe down with clean rags to remove dust, dirt and metal shaving prior to shipping. Seal exterior opening be shipment.

B. Deliver air-handling units and systems to project site on the UCI campus. Store units under cover and elevated above grade. Protect from weather and construction traffic and debris. Handle carefully to avoid damage to components, enclosures, and finish.

1.7 PROJECT CONDITIONS

A. Do not operate unites for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, shipping bolts removed and fan has been test run under observation.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of prefilters and One set of main filter for each air-handling unit.
2. Gaskets: One set for an access door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Enterprises.
2. Energy Labs
3. Haakon Industries
4. Huntair, Inc.
5. TMI

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section 01 6000, “Product Requirements”,

Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 MANUFACTURED UNITS

A. Custom air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, condensate pans, mixing dampers, control devices, sound attenuators, and accessories.

2.3 CABINET

A. Construction: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed and constructed with thermal breaks.

1. Outside Casing: 16 gage G-90 galvanized steel.
2. Inside Casing: 22 gage G-90 galvanized steel with the following exceptions; 22 gage perforated G90 galvanized steel liner at fan sections; and 22 gage 304 stainless steel liner at outside air section and coil section. Floor Plate: material is 1/8" thick safety tread surface aluminum sheet. Provide convenience drains for each section to allow efficient wash down of units. Drains shall be 1¼" pipe size minimum and shall be piped to the exterior of the unit. Provide red brass or copper tubing rather than steel piping. Finish with male pipe threads and cap.
3. Panel Fasteners: Screws or bolts shall be galvanized, or stainless steel at maximum 9-inch on centers. If screws are used, screw tips shall not protrude into maintenance access space, presenting a safety hazard to maintenance personnel.
4. Rigidity: Reinforcement of the unit is required to limit deflection to 1/200 when static pressure is at 8-inches of water column, or 1.5 times the fan static pressure, whichever is greater.
5. Structure: Structural members shall be insulated in the same fashion as the insulated panel in order to reduce sound transmission, and surface condensation. Through metal connections, or "bridges" shall be kept to an absolute minimum.
6. Base: Welded steel base of minimum 8 inches high structural tubes or channels around the entire perimeter, and welded structural angle-iron, beams, or channels beneath the fan sections and coils. Welded or bolted cross-members shall be provided for lateral stability, and fully self-supporting system for installation on concrete housekeeping pad.
7. Casing Openings: If horizontally ducted side connections are used, duct connections shall be a minimum 6-inches above the AHU access door threshold.
8. Penetrations: Supply, return, and outside air penetrations shall be low-pressure drop design.
9. Through Penetrations: Conduit and piping penetrating the AHU casing shall be sealed airtight and watertight with an approved sealant. Ensure sealing of chilled water piping where it passes through casing wall.

B. Cabinet Insulation: Comply with CMC.

1. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of Type II glass fibers.
2. Thickness for wall and roof: 4 inches.
3. Thermal Conductivity (k-Value): 0.24 btu inch/ft^2 at 70 deg F mean temperature.
4. Density: 3 lbs/ft^3.

5. Fire-Hazard Classification: Maximum flame-spread index per ASTM E84 of 25 and smoke-developed index of 50, and flame propagation index of 50 when tested according to ASTM C 411.
6. Liner Adhesive: Comply with NFPA 90A and ASTM C 916.
7. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
8. Location and Application: Encased between outside and inside casing.

C. Access Doors: One door for each air handling unit section of same materials and finishes as cabinet, complete with hinges, latches, handles, and gaskets.

1. Door frames: 16-gage welded construction.
2. Doors: Double-wall, minimum 2-inch thick, 16 gage G-90 galvanized steel; exceptions, interior 18 gage 304 stainless steel for outside air section access door, and for cooling coil section access door. Door swing shall be against the pressure, holding the door firmly against the door seal without latching the lever handle. Door sizes shall be minimum 22-inch wide by 72-inch high, except when limited by air handling unit height.
3. Gasket: Hollow closed-cell elastomeric gasket or seal.
4. Hinges: Adjustable heavy duty corrosion resistant capable of suspending a 100 pound weight placed on the latch end of the door without deflection.
5. Door Handle: Adjustable corrosion resistant alloy lever cam action handles on both sides of door.
6. Instrument Test Port: Access doors shall be equipped with Ventfabrics Model #699 or equal, screwed and gasketed instrument test port. Provide any additional test ports if necessary to allow measurement of the pressure drop across any apparatus in the air handling unit.
7. Fan section Doors: Fan section door, or removable fan section panel shall be large enough to accommodate removal of fan wheel and/or motor.

D. Condensate Drain Pans: Formed sections of 16 gage 304 stainless-steel sheet complying with requirements in ASHRAE 62. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends) and moisture eliminator sections.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Slope: Pan shall be sloped ¼” per foot.
3. Drain Connections: 304 stainless steel pipe to outside of unit.
4. Drain Outlet: Bottom, or recessed side outlet.
5. Dimensions: Extend pans downstream of coil edge 1/3 the height of the coil, minimum of 12-inches. Minimum depth shall be 1½-inches deep.
6. Units with stacked coils shall have an intermediate stainless steel drain pan or drain trough to collect condensate from top coil. Provide insulation on bottom of intermediate drain pan.

7. All parts in contact with cooling coil shall be 304 stainless steel.
8. Anchorage: Condensate drain bracket, support, and fastener, material shall be 304 stainless steel.

E. Finish: Salt spray test passing ASTM B-117, D-2247, and D-3359. Paint exterior of the unit casing and doors.

1. Outdoor Units: Polyester coated for a minimum of 4,000 hours salt spray resistance test.

F. Casing and Liner Joints: Seal air handling unit wall panels, floors, liners, and door joints for an airtight and watertight seal, encapsulating the insulation.

1. Sleeves and sealant shall be used on all cabinet electrical and piping penetrations.
2. Cabinet shall conform to ASHRAE/ANSI Standard 111, Leakage Class 9.
3. Assembled unit shall have maximum leakage rate of 1% of total airflow.
4. Flooring shall be of completely watertight construction with minimum 1-1/2-inch raised dams as necessary to contain any potential spills, with low spill point dumping into the mechanical room.
5. Gasket and sealant between panels.

G. Motor Rail: Include a structural I-beam over the motor and to the access door for removal of the motor from the unit with a chain hoist.

2.4 FAN SECTION

A. Fan-Section Construction: Direct-drive plenum fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with vibration isolation. Fans shall be selected based on future capacity.

B. Plenum Fan: Completely welded aluminum, direct drive, airfoil blades, taper lock or taper bushing to shaft.

1. Supports: Structural steel tube, steel angle- or channel-iron member supports for mounting and supporting fan wheel, motor, and accessories.
2. Performance Class: AMCA 99, Class II minimum.
3. Safety: Cal-OSHA approved inlet screen and safety devices.
4. AMCA Seal: Fan assembly shall be licensed to bear the AMCA Seal.
5. Inlet: Precision spun inlet cone.
6. Drive: Direct, with coupler.
7. Coatings: Powder-baked enamel.
8. Arrangement: arrangement 4.

C. Fan Assemblies: Statically and dynamically balanced at the factory and designed for continuous operation at maximum rated fan speed and motor horsepower.

D. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Solid steel ground and polished. Shaft shall be rated to operate at 20% greater speed than the maximum AMCA Class speed of the fan.

E. Vibration Control: Install fans on welded structural steel base with restrained-spring vibration isolators having a minimum of 2-inch static deflection, selected for seismic zone 4 compliance, with thrust restraint. On fan sizes 54-inch and larger, 3-inch static deflection is required. Provide flexible connectors complying with NFPA 90A. H. Fan-Section Source Quality Control:

1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCAcertified sound ratings seal.

2.5 MOTORS

A. General: Totally enclosed, fan-cooled, cast-iron frame, premium efficient and compatible for inverter duty service with VFD. Refer to Division 23 Section "Motors for HVAC" for requirements.

B. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.

C. Motor Sizes: large enough so driven load will not require motor to operate in service factor range.

D. Overload Protection: Built-in, automatically resetting, thermal-overload protection.

E. Nameplate: Indicate ratings, characteristics, construction, special features, and full identification of manufacturer.

F. Disconnect Switch: Mounted in an accessible location inside air handling unit casing or within 10 feet of motor.

2.6 VARIABLE FREQUENCY DRIVE

A. Refer to Division 23 Section "Variable Frequency Drives" for general requirements. VFD shall be installed integral to the AHU casing in a ventilated compartment, within the VFD manufacturers NEMA 1 enclosure. VFD shall be rated for compatibility with motor, and factory

wired with stranded copper in watertight flexible conduit to motor. Drive and motor shall be mounted, wired, and tested at the factory.

2.7 COILS

A. Coil Sections: Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.

B. Water Coils: Continuous circuit coil fabricated according to ARI 410, counterflow design, closed-cell insulation on tube bends and headers and any chilled water piping within casing and casing wall.

1. Arrangement: Horizontally stacked coils, individually removable.
2. Piping Connections: Threaded or flanged, on same end.
3. Tubes: minimum 5/8-inch outside diameter Copper tubes, minimum 0.025-inch tube wall thickness, with 0.030-inch thick tube bends, and minimum 48-inch support spacing. Tubes must be of round and open cross-section, void of flow enhancement accessories.
4. Rows: maximum 8.
5. Fins: Copper with corrugated fins and minimum thickness size of 0.0095-inches, and maximum of 9 fins/inch.
6. Fin and Tube Joint: Mechanical bond copper fin to copper tube.
7. Headers: Seamless copper tube with brazed joints, prime coated, with ½" copper or red brass vent and drain piping extensions to outside of the panel wall.
8. Heating Coil Frames: Minimum 16 gage G-90 galvanized-steel channel frame, with minimum ¾" flanges.
9. Cooling Coil Frames: Minimum 10 gage 304 stainless steel channel frame, with minimum ¾-inch flanges.
10. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.

    a. Working-Pressure Ratings: 200 psig, 325 deg F.

10. Source Quality Control: Test with 300 psig air underwater.
11. Air and drain lines shall be extended to outside of unit casing.

2.8 DAMPERS

A. General: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

B. Low-Leakage Outside air, return and relief Dampers: Double-skin, airfoil-blade extruded aluminum dampers with compressible jamb seals and rubber, or extruded-vinyl blade edge seals, in opposed-blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings bronze bushings or ball bearings, mounted in a extruded aluminum frame, and with

concealed square or hexagonal zinc plated operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.

1. Outside-Air/Relief-Air: Extruded aluminum frame, damper, axle, and accessories.
2. Option bearings may be composed of a Celcon inner bearing fixed to a $^{7}/_{16}$" aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
3. Units with 100% outside air that are 24/7 operation do not require outside air damper.

C. Fan isolation dampers required for units installed in parallel shall be in accordance with Division 23 Section "Air Duct Accessories." Fan isolation damper shall be an industrial type that will close against pressure.

2.9 FILTER SECTION

A. Filters: Comply with NFPA 90A.

B. Filter Section: Provide filter holding frames arranged for flat orientation.

1. Holding Frame: Type 8, 16-gage stainless steel with welded corners. Complete with filter hold-down clips.
2. Frame Stiffener: 3/16-inch thick stainless steel stiffeners are required at 4-foot intervals on filter frame configurations larger than 4-high by 3-wide.
3. Configuration: Flat face holding frame, provide only in 24-inch by 24-inch modules.
4. Blank-off: 16-gage stainless steel sheet blank-off's at irregular shapes at filter bank perimeter as required. Permanently fasten and seal blank-off panels for an airtight seal.
5. Frame Seal: Seal between filter supports and at plenum housing to prevent day lighting for an airtight seal, with permanent frame mounted closed-cell foam gasket for sealing against filter.
6. Filter Gage: Dwyer 2000 series magnahelic, mounted for reading differential pressure across filter bank, 0-2-inch scale.
7. Filter media: For filtration requirements, see equipment schedules on drawings. Provide 2-stage filtration comprised of 2-inch thick 30% efficient ASHRAE throwaway filters (MERV 8), and 85% efficiency ASHRAE filters (MERV 13), unless otherwise indicated.
8. Provide filter frame and racks of stainless steel construction for 100% outside air units.

2.10 AIR FLOW MONITORING STATION

A. Fans shall be supplied with a complete flow measuring system capable of supplying a 4 – 20mA. Output signal to the BMS system that is proportional to airflow.

B. Manufacturer: Haakon AFM.

C. Flow Station Requirements:

1. The flow measuring station and a flow transmitter shall be factory mounted. The flow measuring station shall consist of pressure taps pick-ups located in the inlet cone of one fan per array. The flow measuring station shall be capable of being relocated from one fan to another in the event that the fan in which the flow station is measuring fails. There shall be no obstruction created on the inlet of the fan by installation of flow measuring device. Flow measuring stations installed in the inlet of fan will obstruct the fan inlet and will decrease fan efficiency and increase sound power levels. Provide a gauge with CFM scale on external side of the fan sections, which indicates the fan volume.
2. The electronic flow transmitter shall be mounted on the exterior of the fan section. It shall be capable of receiving signals of total and static pressure from a flow element, of amplifying, extracting the square root, and scaling to produce a 4 - 20 mA or 0 - 5 VDC output signal linear and scaled to air volume or velocity. The flow transmitter shall be capable of the following performance and application criteria.
3. Calibrated spans from 0 - 896 FPM, in eight flow range increments. Output signal 4 -20 mA or 0-5 VDC standard. Integral zeroing means 3-way zeroing valve with manual switch. Temperature effect ± 2.0% of full span from 40° to 120°F.
4. The transmitter shall not be damaged by over-pressurization up to 200 times greater than span, and shall be furnished with a factory calibrated span and integral zeroing means. The transmitter shall be housed in a NEMA 12 enclosure with external signal tubing, power, and output signal connections.

2.11 LIGHTING

A. Vapor proof cast-aluminum marine light with guard, L.E.D., with EMT runs inside of unit serving lights in each section of the unit. Locate solid-state timer/switch on exterior adjacent to fan access door with independently fed lighting circuit – separate from unit power connection. Provide a minimum of 2 lights per section or a two lamp 4 foot fluorescent T-8 lamp with sealed lens for wet environment and electronic ballast.

B. Light fixtures shall be located at the least likely location that they would be bumped or knocked by maintenance staff. That may include ceiling or wall and the location shall be reviewed by the University's Representative.

2.12 ELECTRICAL

A. Electrical work shall be in accordance with current California Electric Code.

B. The mounting height of the units disconnect switches shall be coordinated with the installed working surface to meet the NEC requirements of 6'-7" or less.

C. Wiring inside unit sections shall be installed inside conduit. Conduit to fan motors shall not run across floors or be installed to prevent normal maintenance access. Provide stranded copper wire in a watertight flexible conduit for final connection to motor.

D. VFD for fans factory mounted.

E. Wiring inside units shall be factory installed.

2.13 ACCESSORIES:

A. Blank-off panels: Galvanized to match interior. Permanently fasten and seal blank-off panels for an airtight seal.

B. Lifting Lugs: Factory mounted and adequately sized lifting lugs for each component shipped.

C. Piping penetrations: Extend air lines to exterior of AHU cabinet and cap ½" brass female pipe threads.

2.14 OUTDOOR UNITS

A. Rooftop air handling units shall meet the requirements of this specification, shall be completely weatherproof, and shall meet the following requirements:

1. Doors, access panels, and casings shall have weatherproof gaskets and seals.
2. Storm Louvers:

a. Blades: drainable blade storm type with drain gutter in each blade, stainless steel, or 6063-T5 aluminum alloy. Air velocity at full economizer cycle shall not exceed 900 fpm, and shall not allow moisture carryover.
b. Downspouts: shall be provided in frame jambs and mullions.
c. Frames: aluminum
d. Screen: removable stainless steel bird screen.
e. Supports: designed to withstand wind load of 20 lb/ft^2.
f. Certification: certified and licensed to bear the AMCA Seal.

4. Lighting, switches, convenience outlets, controls, wiring, cabling and instruments shall be suitable for outdoor applications.
5. Exterior Finish: Exterior finish shall withstand 4,000 Hour salt spray testing as prescribed in ASTM B117 Operating Salt Spray (Fog) Apparatus.

Roof shall be sloped to drain, and shall not allow standing water. 2.15 SOUND POWER RATING (BASED ON)

OCTAVE BAND SOUND POWER LEVELS (Lw) in HERTZ, (dB re: 10-12 Watts)								
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
OCTAVE BAND SOUND POWER LEVELS (Lw) in HERTZ, (dB re: 10-12 Watts)								
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
AHU-01 Outlet	91	86	89	87	86	81	77	72

AHU-01 Inlet	77	78	83	83	78	78	76	74
AHU-01 Casing Radiated	73	61	50	50	50	50	50	50
AHU-02 Outlet	92	86	90	88	87	82	79	73
AHU-02 Inlet	77	79	84	84	78	77	77	74
AHU-02 Casing Radiated	74	61	51	50	50	50	50	50
AHU-03 Outlet	85	79	83	82	81	75	72	66
AHU-03 Inlet	78	79	84	83	78	77	76	74
AHU-03 Casing Radiated	75	62	52	50	50	50	50	50

PART 3 - EXECUTION

3.1 EXAMINATION Examine areas and conditions for compliance with requirements for University's standards for maintenance access, installation tolerances and other conditions affecting performance.

B. Examine roughing-in of hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

C. Verify that pads or bases are level. Provide shims if necessary.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Concrete Bases: Install floor and roof mounting units on a minimum 6-inch- high concrete bases or pad. Adjust concrete base height as required to lift AHU in order to fit static condensate trap. See Division 23 Section "Common Work Results for HVAC" for concrete base materials and fabrication requirements. Secure units to concrete bases with concrete anchor bolts.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

C. Use factory provided lifting lugs to rig the units. Spreader bars must be used to prevent damaging the casing.

D. Electrical Conduit: Route control tubing, control wiring, smoke detector wiring, if applicable in electrical conduit. Conduit must not be anchored with screw penetrations into AHU casings.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance. Piping shall not cause tripping hazard or be in path of travel to access doors.

C. Connect condensate drain pans using NPS 1-1/4, Type L copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction in accordance with Campus Standard piping details.

D. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping and Valves." Connect to supply and return coil tappings with union or flange at each connection.

E. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Internally isolated units do not need external duct flex connection.

F. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls. Provide conduit for internal wiring.

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Final Checks before Startup: Perform the following:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Lubricate bearings, pulleys, and other moving parts with factory-recommended lubricants.
5. Set outside- and return-air mixing dampers to minimum outside-air setting.
6. Comb coil fins for parallel orientation.
7. Install clean filters.

C. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Division 23 Section “Commissioning for HVAC” and Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

3.7 CLEANING

A. Clean air-handling units internally, on completion of installation, according to manufacturer's written instructions.

B. After completing system installation and testing, adjusting, and balancing, air-handling and air distribution systems, clean filter housings and install new prefilters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain air-handling units. Refer to Division 01 Section “Demonstration and Training."

END OF SECTION 23 7513

SECTION 23 8113 - HYDRONIC heating PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping, special-duty valves, and hydronic specialties for hot-water heating, chilled-water cooling, process cooling loops, and condenser water systems; makeup water for these systems; blowdown drain lines; and condensate drain piping.

B. Related Sections include the following:

1. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
3. Division 23 Section "Common Work Results for HVAC" for general piping materials and installation requirements.
4. Division 23 Section "Hangers and Supports for HVAC" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
5. Division 23 Section "Mechanical Vibration and Seismic Controls for HVAC" for flexible pipe support and anchorage product descriptions, and installation requirements.
6. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for flexible pipe accessory product descriptions, and installation requirements.
7. Division 23 Section "Meters and Gages for HVAC" for thermometers, flow meters, and pressure gages.
8. Division 23 Section "Identification for HVAC" for labeling and identifying hydronic piping.
9. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
10. Division 23 Section “HVAC Water Treatment” for chemicals, feeders and water treatment requirements.
11. Division 23 Section "Instrumentation and Controls" for temperature-control valves and sensors.

1.2 SUBMITTALS

A. Product Data: For each type of valve indicated. Include flow and pressure drop curves based on manufacturer's testing for valves, diverting fittings, manual calibrated balancing valves, and automatic flow-control valves.

B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

E. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 01.

F. Piping, fittings, and accessories: For each type of materials indicated, including gaskets.

1.3 QUALITY ASSURANCE

A. Delete paragraph below if no welding. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.4 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Penetration Firestopping" for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grooved Mechanical-Joint Fittings and Couplings:

   a. Anvil International, Inc.
   b. Victaulic Company of America.
   c. Or equal.

2. Manual Calibrated Balancing Valves:

   a. Armstrong
   b. Griswold Controls.
   c. Tour and Andersson
   d. Victaulic Company of America
   e. Or equal.

3. Pressure-Reducing Valves:

   a. Conbraco Industries, Inc.
   b. Hersey
   c. Febco
   d. Watts Industries, Inc.; Watts Regulators.
   e. Or equal.

4. Safety Valves:

   a. Conbraco Industries, Inc.
   b. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
   c. Kunkle Valve Division.
   d. Spence Engineering Company, Inc.
   e. Or equal.

5. Automatic Flow-Control Valves:

   a. Griswold Controls.

b. Or equal (No known equal).

6. Expansion Tanks:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett
   d. Taco, Inc.
   e. Wheatley
   f. Or equal.

7. Air Separators and Air Purgers:
   a. Bell and Gossett
   b. Spiro Research Company; Spirotherm, Inc.
   c. Or equal

8. Piping and fittings:
   a. Pipe and fittings shall be of domestic, Canadian, Australian, or Japanese manufacture.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.

E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe, NPS ¾ through NPS 1½: ASTM A 53, Type S (seamless) Grade A, Schedule 40, black steel, plain ends.

B. Steel Pipe, NPS 2 through NPS 10: ASTM A 53, Type S (seamless) or Type ERW (welded) Grade A or B, Schedule 40, black steel, plain ends.

C. Steel Pipe, NPS 12 and larger: ASTM A 53, Type S or Type ERW (welded) Grade B, 0.375 inch wall thickness, black steel, plain ends.

D. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless.

E. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

F. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

G. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.

H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised or flat face.

I. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.

J. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

K. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

L. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

M. Flexible Connectors and Expansion Joints: See Division 23, Section “Expansion Fittings and Loops for HVAC Piping”.

2.5 VALVES

A. Ball Valves: (Sizes NPS ½"– 2", typical)

1. Two-Piece, copper-alloy, MSS SP-110, Bronze body with full-port, 316 stainless steel ball and stem PTFE seats; and 600-psig minimum CWP rating and blowout-proof stem. Stem length shall clear insulation.

a. Conbraco Industries, Inc.; Apollo Div. Model #77-140 (threaded) or Model #77-240 (soldered)
b. Milwaukee.
c. NIBCO Inc.
d. Or equal.

B. AWWA, Cast-Iron Gate Valves for non-hot water applications:

1. Manufacturers:

a. American Cast Iron Pipe Co.; American Flow Control Div.
b. Crane Co.; Crane Valve Group; Stockham Div.
c. Grinnell Corporation; Mueller Co.; Water Products Div.
d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
e. McWane, Inc.; Kennedy Valve Div.

f. McWane, Inc.; M&H Valve Company Division
g. NIBCO INC.
h. United States Pipe and Foundry Company.
i. Milwaukee.
j. RP&C.
k. Bonney Forge.
l. Or equal.

2. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

a. Minimum Working Pressure: 200 psig.
b. End Connections: Mechanical joint, or flanged.
c. Interior and Exterior Coating: Complying with AWWA C550, epoxy.

C. Cast-Iron Gate Valves for hot water applications:

1. Manufacturers:

a. Type I, Cast-Iron, Rising-Stem Gate Valves:

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Crane Co.; Crane Valve Group; Jenkins Valves.
3) Crane Co.; Crane Valve Group; Stockham Div.
4) Milwaukee Valve Company.
5) NIBCO INC.
6) Powell, Wm. Co.
7) Walworth Co.
8) Watts Industries, Inc.; Water Products Div.
9) Or equal.

2. Cast-Iron Gate Valves, General: MSS SP-70, Type I.

a. Class 125, OS&Y, Cast-Iron Gate Valves: Cast-iron body with bronze trim, renewable bronze seat rings, rising stem, and tapered solid-wedge disc.

D. Check Valves:

1. Sizes NPS ¾"– 2": Ball-Check, spring type, Class 150, MSS-SP-80, two-piece bronze body and seat, full port, blowout proof, threaded ends, stainless steel ball, stem, and spring, Teflon elastomers, Buna-N disc.

a. Crane Co.; Crane Valve Group; Crane Valves
b. Crane Co.; Crane Valve Group; Stockham Div.
c. NIBCO INC.
d. Spriax Sarco
e. Or equal.

2. Sizes NPS 2½"- larger: Swing Check, Type 1, Class 125, MSS-SP-71, cast-iron body, flanged with bronze seat and bronze trim, bolted cap.

a. Crane Co.; Crane Valve Group; Crane Valves. 373.
b. Crane Co.; Crane Valve Group; Stockham Div. G931.
c. NIBCO INC. F-918-B.
d. Or equal.
e. Spirax Sarco.
f. Mueller.

3. Sizes NPS ¾" – 2": Non-slam Check, Class 125, bronze body and seat, tight shut-off, threaded ends. Rated for 200 °F applications.

a. Conbraco Industries, Inc.; Apollo Div. 62-100.

b. Crane Co.; Crane Valve Group; Stockham Div.
c. NIBCO INC. T-480.
d. Spirax Sarco.
e. Mueller.
f. Or equal.

4. Sizes NPS 2½"-larger: Non-slam Check, Type 1, Class 125, MSS-SP-71, cast-iron body, flanged with bronze seat and bronze trim, bolted cap.

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Div.
c. NIBCO INC. F-910.
d. Spirax Sarco.
e. Mueller.
f. Or equal.

E. Iron Butterfly Valves:

1. Sizes 2 ½" and larger: 150 psig CWP rating, cast/ductile iron construction, tight shutoff, lug pattern EPDM liner, lever operator, stainless steel disc, epoxy coated body.

a. DeZurik.
b. Henry J. Pratt Company
c. NIBCO INC.
d. Milwaukee ML 224-E-A
e. Or equal.

F. Manual Calibrated Balancing Valves, NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain manually set position.

G. Manual Calibrated Balancing Valves, NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain manually set position.

H. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

I. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

J. Automatic Flow- Limiting Device: factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with test probes. Each valve shall have an identification tag outside of insulation attached by chain, and be factory marked with the zone identification, valve number, and flow rate. The body shall bear factory standard product tag. Valve shall be line size and one of the following designs depending on the system:

1. Gray-iron or brass body, designed for 175 psig at 200 deg F with stainless-steel cartridge/piston and spring.
2. Brass body, designed for 175 psig at 200 deg F with stainless-steel cartridge/piston and spring.

K. Pressure Sustaining and Pressure Regulating Valve: The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

1. Valve body shall be of cast Ductile Iron material and have stainless steel trim.
2. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert.
3. The diaphragm assembly containing a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off.
4. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve with stainless steel trim designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a fixed orifice. The pilot system shall include an opening speed control on all valves 3” and smaller on the model 92-01 and 4” and smaller on the model 692-01, as standard equipment. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge.
5. The pressure sustaining pilot control shall be a direct-acting adjustable spring loaded control which opens when upstream pressure exceeds the spring setting on the pilot. The pilot control system shall include an X44A strainer & orifice assembly.

6. A full range of spring settings shall be available in ranges of 0 to 450 psi. Downstream spring range shall be 2-30 psi.
7. A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.
8. The valve shall be a Cla-Val Co. Model No. 750-01 Combination Pressure Reducing & Sustaining Valve as manufactured by Cla-Val Co., Newport Beach, CA 92659-0325 or equal.

L. Refer to Part 3 "Valve Applications" Article for applications of each valve.

M. Combination duty type valves and fittings shall not be used.

N. Combination Assemblies: Individual threaded components, ball valves, control valve, automatic flow limiting device of brass body construction, fitted with pressure and temperature test valves, strainer, flexible hoses, and designed for 300 psig at 250 deg F for duct or terminal mounted heating coils. See Campus Standard detail.

2.6 HYDRONIC SPECIALTIES

A. Manual Air Vent Bronze body ball valve with stainless steel ball; NPS ½.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS ½" or ¾" inlet connection. Provide only one automatic air vent in system at air separator.

C. Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature with rustproof coating. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, shipped with minimum of 12 psig charge.

D. Air Separators: Welded black steel; ASME constructed and labeled for 150 psig minimum working pressure and 250 deg F maximum operating temperature; tangential Viton seal and Oring brass vent head and skim valve, copper coalescing medium, non-ferrous float, in-line inlet and outlet connections; threaded connections for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger; threaded blowdown connection. Provide units in sizes for full-system flow capacity with pressure loss performance of less than one foot of water, and maximum velocity of 4 feet per second, as manufactured by Spirotherm, or equal as manufactured by

others with greater than line size inlet as required to meet performance requirement of less than one foot of water at design flow capacity. E. Y-Pattern Strainers NPS 2 and smaller:

1. Strainers 2" and smaller for heating and air conditioning water service shall be based on Watts No. 777 or an equivalent strainer by Armstrong or equal, 400 psig WOG bronze body, threaded, Y-pattern, 20-mesh stainless steel screen, with a full size drain connection and ball valve.

F. Y-Pattern Strainers NPS 2-1/2 and larger:

1. Strainers 2-1/2" and larger for heating and air conditioning water service shall be based on Watts No. 77F-DI, Keckely Style "A", or an equivalent strainer by Armstrong or equal, Class 125 cast-iron body, flanged, Y-pattern, stainless steel screen, with a drain connection and ball valve (as described elsewhere herein).

G. Suction Diffuser: Angle or straight pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot Water Heating and Chilled Water (above ground):

1. NPS 2 and smaller: Type L copper; with 95-5 soldered wrought copper fittings.
2. NPS 2-1/2 and larger: Black steel pipe, ASTM A53, Type S (seamless) or Type ERW (welded); with standard weight ASTM A234 forged steel fittings for butt-weld connection or 150 lb; or grooved mechanical joint coupling and fittings with roll grooved mechanical joints.

B. Heating and Chilled Water Pot Feeder:

1. Type L Copper: Type L copper: with 95-5 soldered wrought copper fittings.

C. Equipment Connections

1. NPS 2 and smaller: Use union connections.
2. NPS 2-1/2 and larger: Use flange connections.
3. Dissimilar metals: Where piping is connected to equipment with different materials, such as ferrous to copper, use brass union, brass coupler, brass pipe/nipple in order to prevent electrolysis.

4. Valves: Provide shut-off duty isolation valves and strainers at all equipment.
5. Flexible Piping Connectors: Provide flexible piping connectors at each piece of equipment unless acoustic consultant determines such devices are not required to meet project sound and vibration performance requirements.

D. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications for hydronic systems unless otherwise noted, use the following valve types:

Type	**Minimum Size**	**Maximum Size**	**Valve Service:**
Ball	¾"	2 "	Shut-off, and Throttling duty.
Gate, AWWA (chilled water)	2½"	12"	Shut-off duty.
Butterfly (chilled water only)	2 ½"	n/a	Shut-off duty.
Gate, rising stem (hot water)	2½"	n/a	Shut-off duty.
Ball - Check (hot water)	¾"	2"	Check valve.

B. Install main building shut-off valves for hydronic systems.

C. Install shutoff duty valves at each riser branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line.

D. Install auto flow limiting balancing valves in the return water line of each heating or cooling element. Install manual calibrated balancing valve at split coils as shown on the University's standard coil piping diagram.

E. Reheat Coils: Provide combination assemblies as described in Part 2, with flow limiting device and flexible hose connections.

F. Hydronic systems which utilize flow limiting devices as balancing means shall include flow limiting devices on all system user branch take-off's at heat exchange device for system uniformity and proper system balance and operation.

G. Combination duty type valves and fittings shall not be used.

H. See Division 23 Section “Instrumentation and Controls” for hydronic control valve requirements.

I. Install check valves at each pump discharge and elsewhere as required to control flow direction.

J. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

K. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

L. All water valves operating between 32 and 95°F and larger than 2” shall be butterfly valves. Where the valves are insulated to prevent sweating (e.g. chilled water) the valves shall be non-rising stem. Other applications may be either rising stem or non-rising stem as required. Except where buried outside, the valves shall have handwheels. Buried valves shall have 2” square operating nut.

3.3 PIPING INSTALLATIONS

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping installation requirements.

B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

D. Install piping level or at a uniform grade of 0.2 percent in direction of flow or a drain.

E. Where possible, educe pipe sizes using eccentric reducer fitting installed with level side up- top flat.

F. Install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

H. Anchor piping for proper direction of expansion and contraction.

I. Do not use groove-joint fittings on insulated piping system, unless insulation system is specifically designed for groove-joint fittings. J. Avoid underground piping.

K. Piping penetrations shall be carefully detailed. Insulation through penetrations shall be continuous.

L. Bushings and short nipples shall not be used.

M. Avoid pipe joints located over, or within 2 feet of electrical equipment. If it cannot be avoided provide with drip pans.

N. Teflon tape shall be utilized for threaded pipe joints.

O. Provide pipe and fittings of similar materials so dielectric fittings are not needed; i.e. only brass and bronze fittings with copper piping.

P. Grooved Mechanical-Joint Fittings and Couplings:

1. Piping shall be roll grooved only. Cut groove piping is not allowed.
2. Gaskets shall be EPDM.
3. Install per manufacturer’s installation instructions.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC." Comply with requirements below for maximum spacing of supports. B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze When necessary..
4. Spring hangers to support vertical runs.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

NPS	Maximum span (feet)	Minimum rod size (inches)
3/4	7’	¼”
1	7 ‘	¼”
1-1/2	9’	3/8”
2	10’	3/8”
2-1/2	11’	3/8”
3	12’	3/8”
4	14’	½”
6	17’	½”
8	19’	5/8”
10	20’	¾”
12	23’	7/8”
14	25’	1”
16	27’	1”
18	28’	1-1/4”
20	30’	1-1/4”
24	32’	1-1/4”

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes. Comply with hanger manufacture spacing requirements.

NPS	Maximum span (feet)	Minimum rod (inches)
3/4	5 ‘	1/4 “
1	6 ‘	1/4 “
1-1/2	8 ‘	3/8 “
2	8 ‘	3/8 “
2-1/2	9 ‘	3/8 “
3	10 ‘	3/8 “

E. Support vertical runs at roof and at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install one automatic air vent per system in mechanical equipment rooms only at air separator for system air venting.

C. Install in-line air separators in pump suction lines. Install drain valve on units NPS 2 and larger.

D. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

E. Provide pot-feeder in heating systems and only in non-central plant chilled water systems.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections.

B. Install shut-off valves, strainers, accessories, and flexible hose threaded connections.

C. Install control valves in accessible locations close to connected equipment.

D. Never install bypass piping around control valves.

E. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test at 150 PSI or 1.5 times the design pressure, whichever is greater, for four hours. There shall be no decrease in pressure over the four hour test period. Isolate equipment subject to damage from test pressure. Make no test against a service valve or meter. Isolate from the system all existing piping and new or existing equipment that may be damaged by test pressure. Test only new piping unless instructed otherwise. Final connection between new and existing piping shall be tested at normal system operating pressures and monitored for leaks for three working days. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied, examine piping, joints, and connections for leakage throughout the testing period. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

c Hydronic piping outside the building may be pre-tested with air at 100 psi. Upon successful testing, pipe may be buried and tested at a later date.

3.9 ADJUSTING

A. Perform these adjustments before operating the system:

1. Open valves to fully open position.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vent at air separator and determine if it is operating freely (automatic type).
5. Check air vents at high points of system and bleed air completely (manual type).
6. Set temperature controls so all coils are calling for full flow.
7. Check and set operating temperatures of heating and chilled water systems to design requirements.
8. Lubricate motors and bearings.

3.10 CLEANING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 23 2113

SECTION 23 8216 - AIR COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of air coils that are stand-alone or an integral part of air-handling units:

1. Hot-water.

B. Related Sections include the following:

1. Division 23 Sections for air-handling units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

1. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

PART 2 - PRODUCTS

2.1 WATER COILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerofin Corporation.
2. Heatcraft Refrigeration Products LLC; Heat Transfer Division.
3. RAE
4. USA Coil & Air.

B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 250 psig, 300 deg F.

D. Source Quality Control: Factory tested to 300 psig.

E. Tubes: ASTM B 743 copper, minimum 0.020 inch thick.

F. Fins: Aluminum, minimum 0.008 inch thick.

G. Headers: Seamless copper tube with brazed joints, prime coated.

H. Frames: Galvanized-steel channel frame, minimum 0.064 inch thick for flanged mounting.

I. Hot-Water Coil , Face-and-Bypass Dampers: Alternating arrangement of coil segments and dampers.

1. Coil Configuration: Horizontal tubes.

J. Hot-Water Coil Characteristics:

1. Minimum Fin Spacing: 0.083 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Install stainless-steel drain pan under each cooling coil and under each coil located over electrical equipment or in IT/Communications rooms.

1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1-2007.
2. Construct drain pans to extend beyond coil length and width and to connect to condensate trap and drainage.
3. Extend drain pan upstream and downstream from coil face.
4. Extend drain pan under coil headers and exposed supply piping.

D. Straighten bent fins on air coils.

E. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Provide air vent and drain valve at each coil.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 23 8216

SECTION 23 8219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.
2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2013ASHRAE 62.1-2013, Section 5 - "Systems and Equipment."

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

D. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE/IESNA 90.1-2013 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: Furnish one spare fan belt for every 50 units installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each fan-coil unit is based on the product named on the drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 DUCTED FAN-COIL UNITS

A. Manufacturers:

1. Carrier Corporation.
2. Daikin
3. Environmental Technologies, Inc.
4. International Environmental Corporation.
5. Trane.
6. YORK International Corporation.

B. Description:

1. Furnish and install horizontal concealed direct drive fan coil units of the size and capacity indicated on the plans and in the specifications. All units shall be capable of meeting or exceeding the scheduled capacities for cooling, heating and air delivery.
2. Units shall be completely factory assembled, tested and shipped as one piece. All unit dimensions for each model and size shall be considered maximums.

3. Units shall be ETL listed in compliance with UL/ANSI Standard 1995, and be certified as complying with the latest edition of ARI Standard 430 and ASHRAE 33.

C. Coil Section Insulation:

1. 1/2-inch thick, Elastomeric Closed Cell Foam Insulation. Insulation shall conform to UL 181 for erosion and NFPA 90A for fire, smoke and melting, and comply with a 25/50 Flame Spread and Smoke Developed Index per ASTM E-84 or UL 723.
2. Insulation shall comply with Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Polyethylene insulation is not acceptable.
3. All concealed units shall have a minimum 1 1/4" duct collar on the discharge. Plenum units shall have a minimum 1" duct collar on the return.
4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2013.

D. Drain Pans:

1. Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2013.
2. The drain pan shall be externally insulated with fire retardant, closed cell foam insulation. The insulation shall carry no more than a 25/50 Flame Spread and Smoke Developed Rating per ASTM E-84 and UL 723 and an Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21.
3. Provide a secondary drain connection on the primary drain pan for condensate overflow.
4. Provide a condensate overflow switch in the primary drain pan for condensate overflow.

E. Chassis: Heavy gauge Galvanized steel, with baked-enamel or powder coated finish and removable access panels.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis.
2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
3. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
4. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. 2” Pleated Cotton-Polyester Media: 8 MERV.

H. Hydronic Coils:

1. ARI 410 certified and tagged with an ARI 410 label
2. Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch.
3. Include manual air vent and drain.
4. Coils shall be hydrostatically tested at 450 PSIG air pressure under water, and rated for a maximum of 300 PSIG working pressure at 200°F.

5. Heating coils shall be furnished in the reheat or preheat position.

I. Fan Assembly:

1. Direct-Driven Fans, DWDI, forward curved, centrifugal, constructed of 18 gauge Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
2. The fan assembly shall be easily removable for servicing the motor and blower at, or away from the unit. The entire fan assembly shall be able to come out of the unit by removing four nuts per fan and unplugging the motor(s). Plenum unit fan assemblies shall be easily serviced through the filter opening or through the bottom panel.

3. Motors shall be ECM™ type in compliance with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

J. Mixing Box Section

1. Provide where indicated on the plans.
2. Fully insulated integral mixing box section with return and outside air dampers, including the interconnecting damper linkage.
3. Mixing box section shall be shipped attached to the concealed plenum unit as an assembly.
4. Damper actuator to be factory provided, mounted, and wired to control enclosure

K. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.
3. Provide BACnet interface for central BAS workstation for the following functions:

   a. Adjust set points.
   b. Fan-coil-unit start, stop, and operating status.
   c. Data inquiry including supply- and room-air temperature.
   d. Occupied and unoccupied schedules.

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan-coil units level and plumb.

B. Install fan-coil units to comply with NFPA 90A.

C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect condensate drain to indirect waste.

    a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 23 8219

SECTION 23 8316 – RADIANT HEATING AND COOLING HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. This Section covers the hydronic radiant heating and cooling system.

B. The work in this Section includes, but is not limited to, the following:
   1. Complete radiant heating and cooling system as shown on the contract documents.
   2. Manufacturer-supported system startup and commissioning phase support.

1.3 ACTION SUBMITTALS

A. General: Provide required submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Provide manufacturer’s product submittal data, including pressure and temperature rating, oxygen-barrier performance, and fire-performance characteristics.

C. Shop Drawings: Submit the following piping layouts, calculations and reports.
   1. Piping layout scale: 1/4 inch = 1 foot
   2. Submit manufacturer's detailed drawings showing layouts, fixing details and piping details of all areas where hydronic radiant systems are indicated. Submit a cross-referenced manifold schedule indicating loop lengths, tubing diameter, flow rate, operating water temperatures, and pressure drop to meet the required heating and cooling performance listed on the contract documents along with product and performance data for each component.
   3. Indicate all equipment that are required to control and operate the hydronic radiant system heating and cooling as shown on the plans and described in the sequence of operations.
   4. Provide calculations that support the heating and cooling performance requirements of the hydronic radiant system. These calculations should indicate the slab construction and the depth of the tubing in relation to the exposed surface. Calculations must show the required flow rate, operating temperatures and pressure drops through the system for heating and cooling.
   5. Submit manifold details, including all connections, fittings, valves and mounting requirements.
   6. Submit details for embedded tubing through concrete expansion joints.
   7. Provide drawings showing piping manifold locations and installation details.

8. Provide control sequences and requirements for control hardware devices. Indicate compliance and coordination with requirements of other specification sections.
9. Provide piping sample with complete print stream indicating certification of properties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Provide operation and maintenance manuals for valves, manifolds, and controls.

B. Closeout Documentation
1. Submit manufacturer's report detailing that the hydronic radiant system has been installed in accordance with the contract documents and the manufacturer's specified instructions. Provide manufacturer’s instructions. Note any exceptions.
2. Submit start-up report demonstrating that system meets required capacity, is fully functional and commissioned to the satisfaction of system manufacturer.
3. Provide final as-built drawings indicating tubing layout, manifold locations, zoning and manifold schedules with details required for installation of the system.
4. Provide documentation indicating that the installer is trained to install the manufacturer’s products.
5. Warranty documents specified herein.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall have demonstrated experience on projects of similar size and complexity with documentation proving successful completion of hydronic radiant system installation and/or training by the PEX tubing manufacturer.

B. Hydronic radiant system manufacturer shall have successfully completed five installations of similar type and scope. Manufacturer shall provide a representative for field support during the installation and commissioning of the hydronic radiant system.

C. Pre-installation Meetings
1. Verify project requirements, substrate conditions, floor coverings, manufacturer’s installation instructions and warranty requirements.
2. Review project construction timeline to ensure compliance or discuss modifications as required.
3. Interface with other trade representatives to verify areas of responsibility.
4. Establish the frequency and construction phase the project engineer intends for site visits and inspections by the PEX tubing manufacturer’s representative.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1. Store PEX tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.
2. Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing to prevent exposure to direct sunlight.

1.7 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
1. Warranty may transfer to subsequent owners.
2. Warranty Period for PEX Tubing: 30-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of installation.
3. Warranty Period for Manifolds and Fittings: 5-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of installation

PART 2 - PRODUCTS

2.1 CROSSLINKED POLYETHYLENE (PEX) PIPE AND FITTINGS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Unonor
2. Heat Link
3. Mr. PEX
4. Viega ClimateMat

B. To ensure system compatibility consistency, all products, manifolds, components, etc. specified herein must be manufactured by and/or available from the PEX tubing manufacturer.

C. Tubing
1. Material: Engel-method crosslinked polyethylene (PEX-a)
2. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third-party agency.
3. Pressure Ratings: Standard Grade hydrostatic design and pressure ratings as issued by the Plastics Pipe Institute (PPI), a division of the Society of the Plastics Industry (SPI).
    a. 200 degrees F (93 degrees C) at 80 psi (551 kPa)
    b. 180 degrees F (82 degrees C) at 100 psi (689 kPa)
    c. 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa)
4. Show compliance with ASTM E119 and ANSI/UL 263 through certification listings through UL.
    a. UL Design No. K913 ─ 2 hour concrete floor/ceiling assemblies
5. Minimum Bend Radius (Cold Bending): Six times the outside diameter.
6. Barrier Tubing Type: Wirsbo hePEX or equal
    a. Tubing shall have an oxygen-diffusion barrier that does not exceed an oxygen diffusion rate of 0.10 grams per cubic meter per day at 104 degrees F (40 degrees C) water temperature in accordance with German DIN 4726.
    b. Nominal Inside Diameter: Provide tubing with nominal inside diameter in accordance with ASTM F876, as indicated in the system design.

D. Fittings
1. ASTM F1960 cold-expansion fitting manufactured from the following material types:
    a. UNS No. C69300 Lead-free (LF) Brass
    b. 20% glass-filled polysulfone as specified in ASTM D6394
    c. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D6394

d. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D6394
e. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D6394
f. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".

2.2 DISTRIBUTION MANIFOLDS

A. Brass Manifolds

1. Brass manifolds assemblies shall be constructed of dezincification-resistant brass, with minimum 1-inch barrel, sized for flow rates required on submitted manifold schedule, and R32 union connections.
2. Manifold assemblies shall be furnished and installed with:

    a. Supply and return filter ball valves
    b. Supply and return temperature gauges
    c. Loop balancing and isolation valves
    d. End cap with vent and drain
    e. Mounting bracket
    f. Manual balancing valves with visual flow indicators
    g. ASTM F1960 fitting assemblies

3. Install flow setter on the return leg from the manifold to provide flow balancing between manifolds.
4. Manifolds support 5/16-inch through ¾-inch PEX tubing. Use
5. Each manifold location should have the ability to vent air manually from the system.
6. Use appropriately-sized manifolds cabinets to allow the manifold assemblies to be mounted inside the wall cavity. Provide manifold elbows and offsets, as required.

B. Stainless-steel Manifolds

1. Stainless-steel Manifold assemblies shall be constructed of 304L stainless steel, with minimum 1-inch barrel, sized for flow rates required on submitted manifold schedule.
2. Stainless-steel Manifold assemblies shall be furnished and installed with:

    a. Supply and return filter ball valves with NPT threads
    b. Supply and return temperature gauges
    c. Loop balancing and isolation valves
    d. End cap with vent and drain
    e. Mounting bracket
    f. Manual balancing valves with visual flow indicators
    g. ASTM F1960 fitting assemblies

3. Install flow setter on the return leg from the manifold to provide flow balancing between manifolds
4. Manifolds support 5/16-inch through ¾-inch PEX tubing.
5. Each manifold location should have the ability to vent air manually from the system.
6. Use appropriately-sized manifolds cabinets to allow the manifold assemblies to be

mounted inside the wall cavity. Provide manifold elbows and offsets, as required.

C. Copper Manifolds
1. For system compatibility, use 2-inch valved copper manifolds manufactured from Type L copper material, offered by the PEX tubing manufacturer.
2. Install valved copper manifolds primarily for wall-hung or boxed applications.
3. Use manifolds with an isolation valve or a combination isolation and balancing valve on each outlet.
4. Use manifolds that support ⅝ inch or ¾ inch PEX tubing.
5. Ensure manifold end cap offers tapping for ⅛ inch FNPT and ½ inch FNPT for vent and drain.
6. Install supply-and-return piping to the manifold in a reverse-return configuration to ensure self-balancing.
7. If the supply-and-return piping is in direct-return configuration, install and balance flow setters on the return leg of each manifold to the mains.

2.3 PIPING SPECIALTIES AND ACCESSORIES

A. Fixing Wire: 6 inch galvanized steel alloy wire ties shall be used to secure PEX tubing to wire mesh or reinforcing bar.
B. Plastic Cable Tie: Minimum 6 inch polyamide 6/6 nylon cable tie. Minimum 20 lb. tensile strength.
C. PVC Bend Supports: 90 degree PVC bend supports shall be used to sleeve tubing at slab penetrations. Bend supports shall be sized for appropriate tubing diameter.
D. Recessed Manifold Wall Cabinets: Minimum 20-gauge galvanized steel construction with white powder-coat finish. Manifold wall cabinets shall be lockable with removable door-trim package and shall be sized to accommodate the manifolds and associated elbows, valves, pumps, etc. as required by the contract documents.

2.4 CONTROLS

A. Refer to Sections 230900 (Instrumentation and Control for HVAC), Section 230993 (Sequence of Operations for HVAC Controls), and plans for radiant heating and cooling controls.

PART 3 - EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

A. Install radiant heating and cooling system according to approved shop drawings or coordination drawings.

B. Comply with manufacturer’s product data, including product technical bulletins, installation instructions and design drawings.

3.2 EXAMINATION

A. Site Verification of Conditions

1. Verify that site conditions are acceptable for installation of the hydronic radiant heating and/or cooling system.

3.3 INSTALLATION

A. Slab-on-grade Installation
   1. Fasten the tubing to the wire mesh or reinforcing bar using wire ties or plastic cable ties. Space ties at a maximum of 36 inches. Secure tubing at the base and center of each bend.
   2. Fasten the tubing directly onto foam board insulation using plastic foam staples. Use the manufacturer's recommended staple size for the foam board insulation thickness. Space ties at a maximum of 36 inches. Secure tubing at the base and center of each bend.
   3. Fasten the tubing using PEX rails. Rails shall be fastened to the insulation foam board using compatible liquid nails or silicone with maximum spacing of 36 inches.
   4. Install edge insulation when the controlled system directly contacts an exterior wall.
   5. Install tubing at a consistent depth below the surface elevation. Maintain minimum cover as shown on plans. Ensure sufficient clearance to avoid control joint cuts.
   6. In areas where tubing must cross expansion joints in the concrete, ensure the tubing passes below the joints. If tubing must pass through an expansion joint, tubing shall be wrapped with pipe insulation for 6 inches on both sides of joint.
   7. For tubing that exits the slab in a 90-degree bend, use PVC bend supports.
   8. System shall be pressure-tested per the manufacturer's recommendations at a pressure no less than 40 psig. Maintain minimum 40 psig pressure during the concrete pour for 24 hours during curing.

B. Suspended Slab Construction
   1. Fasten the tubing to the wire mesh or reinforcing bar using wire ties or plastic cable ties. Space ties at a maximum of 36 inches. Secure tubing at the base and center of each bend.
   2. Install edge insulation when the controlled system directly contacts an exterior wall.
   3. Install tubing at a consistent depth below the surface elevation. Maintain minimum cover as shown on plans. Ensure sufficient clearance to avoid control joint cuts.
   4. In areas where tubing must cross expansion joints in the concrete, ensure the tubing passes below the joints. If tubing must pass through an expansion joint, tubing shall be wrapped with pipe insulation for 6 inches on both sides of joint.
   5. For tubing that exits the slab in a 90-degree bend, use PVC bend supports.
   6. System shall be pressure-tested per the manufacturer's recommendations at a pressure no less than 40 psig. Maintain minimum 40 psig pressure during the concrete pour for 24 hours during curing.

C. Topping Installation
   1. Fasten the tubing to the wire mesh using wire ties or plastic cable ties. Space ties at a maximum of 36 inches. Secure tubing at the base and center of each bend.
   2. Fasten the tubing using PEX rails. Rails shall be fastened to the structural slab using compatible liquid nails, silicone, or concrete anchors/screws with maximum spacing of 36 inches.
   3. Install edge insulation when the controlled system directly contacts an exterior wall.
   4. Install tubing at a consistent depth below the surface elevation. Maintain minimum cover as shown on plans. Ensure sufficient clearance to avoid control joint cuts.
   5. In areas where tubing must cross expansion joints in the concrete, ensure the tubing passes

below the joints. If tubing must pass through an expansion joint, tubing shall be wrapped with pipe insulation for 6 inches on both sides of joint.

6. For tubing that exits the slab in a 90-degree bend, use PVC bend supports.
7. System shall be pressure-tested per the manufacturer's recommendations at a pressure no less than 40 psig. Maintain minimum 40 psig pressure during the concrete pour for 24 hours during curing.

D. Manifold Installation
   1. Mount manifolds in manifold wall cabinets per the approved shop drawings. Coordinate door panel finish with architectural finish schedule. Install manifold cabinets in accordance with manufacturer's recommendations.

E. All piping to be identified with loop numbers marked on pipe wall before connecting to manifold using a permanent tag.
   1. Verify actual loop length for each loop on a manifold.
   2. All loops must be identified to allow for future balancing.

F. Coordinate slab tubing layout with other devices (electrical conduits and boxes, telecommunication conduits and boxes, plumbing penetrations, construction and furniture supports) and all other services within or attaching to the slab. Zones designated on the drawings shall be kept clear of all radiant floor tubing.

G. Provide survey documentation of tubing layout after installation of tubing and prior to pouring concrete. Notify Owner's Representative three days in advance of concrete pour to allow inspection of installation and survey documentation.

3.4 ADJUSTING

A. Balancing Loops Across the Manifold
   1. Balance all loops across each manifold to the flow rates specified on the approved manifold schedule.
   2. Balancing is unnecessary when all loop lengths across the manifold are within 3% of each other in length. Install the supply-and-return piping to the manifold in a reverse-return configuration to ensure self-balancing.

3.5 CLEANING/RECYCLING

A. Remove temporary coverings and protection.
B. Repair or replace damaged installed products.
C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
D. Remove construction debris from project site and legally dispose of debris. Divert waste tubing and packaging for recycling.

END OF SECTION 23 8316

SECTION 26 0500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Concrete equipment bases.
2. Cutting and patching for electrical construction.

B. Related Sections include the following:

1. Division 07 Section “Penetration Firestopping” for firestopping materials and requirements for penetrations through fire and smoke barriers.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to the University, and marked for intended use.

B. Comply with CEC (NFPA 70).

1.4 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to the University.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.

1. Channel Thickness: Selected to suit structural loading.
2. Fittings and Accessories: Products of the same manufacturer as channel supports.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or clicktype hangers.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends. Provide RK Industries, or approved equal.

F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

G. Expansion Anchors: Carbon-steel wedge or sleeve type.

H. Toggle Bolts: All-steel springhead type.

2.3 CONCRETE BASES

A. Concrete shall be provided by Concrete Contractor.

B. Concrete Forms and Reinforcement Materials: As specified in Division 03 Section "Cast-in Place Concrete."

C. Concrete: Minimum 3000-psi, 28-day compressive strength as specified in Division 03 Section "Cast-in-Place Concrete."

2.4 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

C. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 WIRING INSTALLATION

A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

B. Install wiring at outlets with at least 6 inches of slack conductor at each outlet.

C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use manufacturer’s recommendations.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

3.4 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Install Stiffy hanger rods.

E. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

F. Simultaneously install vertical conductor supports with conductors.

I. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

J. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. New Concrete: Concrete inserts with machine screws and bolts or anchor bolts.
3. Existing Concrete: Anchor bolts.
4. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete when prior approval is received from the University’s Representative.
5. Steel: Screws applicable for application.

7. Light Steel: Sheet-metal screws.

3.5 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Fire stopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.6 CONCRETE BASES

A. Concrete shall be provided by Concrete Contractor.

B. Construct concrete bases of dimensions not less than 8 inches larger, in both directions, than supported unit unless larger is required to comply with seismic restraint requirements. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations. Use minimum 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.8CUTTING AND PATCHING (provided by General Contractor)

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing fire stopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.9 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Supporting devices for electrical components.
2. Concrete bases.
3. Electrical demolition.
4. Cutting and patching for electrical construction.
5. Touchup painting.

3.10REFINISHING AND TOUCHUP PAINTING (provided by General Contractor)

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 09 Section "Interior Painting."

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.11 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 0500

SECTION 26 0513 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cables and related splices, terminations, and accessories for medium voltage electrical distribution systems.

1.2 SUBMITTALS

A. Product Data: For each type of cable indicated. Include splices and terminations for cables and cable accessories.

B. Field quality-control test reports. Submit per Section “Electrical Testing”. Submit megger test reports to EEOR.

1.3 QUALITY ASSURANCE

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

B. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C2 and CEC (NFPA 70).

1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the University or others unless permitted under the following conditions:

1. Notify the University at least 14 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without University Representative written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cables:

a. Kerite Co. (The); Hubbell Incorporated.
b. Okonite Company (The).
c. Pirelli Cables & Systems NA.
d. Rome Cable Corporation.
e. Southwire Company.
f. Or equal.

2. Cable Splicing and Terminating Products and Accessories:

a. Raychem Corp.; Telephone Energy and Industrial Division.
b. RTE Components; Cooper Power Systems, Inc.
c. Thomas & Betts/Elastimold.
d. 3M Company; Electrical Products Division.
e. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 CABLES

A. Cable Type: MV-105.

B. Conductor: Copper

C. Conductor Stranding: Compact round, concentric lay, Class B stranded in accordance with ASTM B-8

D. Conductor Insulation: Ethylene-propylene rubber complying with AEIC CS 6, NEMA WC 8, and ICEA S-68-516, Part 4.

1. Voltage Rating: 15kV.

2. Insulation Thickness: 133 percent insulation level.

E. Shielding: Copper tape helically applied over semi conducting insulation shield.

F. Cable Jacket: Sunlight-resistant PVC.

2.3 SPLICE KITS

A. Connectors and Splice Kits: Comply with IEEE 386; type as recommended by cable or splicing kit manufacturer for the application.

B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

1. Combination tape and cold-shrink-rubber sleeve kit with rejacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.
3. Premolded, cold-shrink-rubber, in-line splicing kit.
4. Premolded EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.

2.4 SOLID TERMINATIONS

A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.
2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
3. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.
4. Class 1 Terminations, Indoors: Kit with stress-relief tube, no tracking insulator tube, shield ground strap, compression-type connector, and end seal.
5. Class 2 Terminations, Indoors: Kit with stress-relief tube, no tracking insulator tube, shield ground strap, and compression-type connector. Include silicone-rubber tape, coldshrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.
6. Class 3 Terminations: Kit with stress cone and compression-type connector.

B. Non-shielded-Cable Terminations: Kit with compression-type connector. Include silicone rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.

2.5 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

C. Load-Break Cable Terminators: Elbow-type units with 200-A load make/break and continuous current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

D. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless steel mounting brackets, and attaching hardware.

1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumper elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

F. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.6 ARC-PROOFING MATERIALS

A. Tape for First Course on Metal Objects: 10-mil- thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, compatible with cable jacket.

C. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch wide.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to the latest IEEE 576.

B. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions, minimum bending radius and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation. Do not use oil, grease, graphite, or similar substances.
2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable. Pulling of conductors in raceways shall be done with an approved cable pulling machine. Other methods such as using vehicles and block and tackle to install conductors are not acceptable.

C. Support cables according to Division 26 Section "Common Work Results for Electrical."

D. Install warning tape 12 inches above cables.

E. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.

F. Arrange cables in manholes on racks. Cables shall rest on insulators supported by racks.

I. Install cable splices at pull points and elsewhere as indicated; use standard kits.

J. Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
2. Portable Feed-Through Accessory: Three.
3. Standoff Insulator: Three.

K. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arcproofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.
2. Wrap metallic cable components with 10-mil pipe-wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
5. Band arc-proofing tape with 1-inch- wide bands of half-lapped, adhesive, glass-cloth tape 2 inches o.c.

L. Seal around cables passing through fire-rated elements according to Division 07 Section "Penetration Firestop Systems."

M. Apply fireproofing tape in half-lapped wrapping. Extend fireproofing one inch into duct.

N. Include separate ground conductor with feeders.

O. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

P. Identify cables according to Division 26 Section “Identification for Electrical Systems”

3.2 FIELD QUALITY CONTROL

A. Testing: Perform megger testing to ensure cabling is acceptable.

END OF SECTION 26 0513

SECTION 26 0519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Insulation Test report. Megger testing shall perform on large feeders only. Submit under Section “Electrical Testing”.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to the University, and marked for intended use.

B. Comply with CEC (NFPA 70).

C. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”,

Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 CONDUCTORS AND CABLES

A. Manufacturers (Building Wire and Cable):

1. CME
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Southwire Company.
5. Cerrowire
6. Or equal

B. Manufacturers (Control Cable):

1. Alpha.
2. Belden.
3. Or equal.

C. Manufacturers (MC cable):

1. AFC Cable Systems.
2. Southwire Company.
3. Or equal.

D. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

E. Conductor Material: Copper complying with ICEA S-95-658 / NEMA WC 70 Nonshielded 0-2 kV Cables.

F. Conductor Insulation Types: Type THW, THHN-THWN, XHHW, UF, USE, and SO complying with NEMA WC 70.

G. Multiconductor Cable: Metal-clad cable, Type MC, THHN copper conductors with integral green ground wire, lightweight steel clad, UL Standard 1569 Type SO and Type USE with ground wire.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.

4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.
6. Arlington
7. Or equal.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits for wet and dry laboratories Concealed in Ceilings, walls and Partitions: Lightweight steel Metal-clad cable.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Lightweight steel Metal-clad cable Type MC or Type THHN-THWN, single conductors in raceway.

H. Lighting Circuits Concealed in Ceiling, Walls, and Partitions: Lightweight steel Metal-clad cable, or Type MC Type THHN-THWN, single conductors in raceway.

I. MC Cables shall be used under the following conditions:

1. Concealed locations only.
2. Lighting and general-purpose power only (not within lab benches)
3. Circuit voltages not exceeding 277V
4. Single vertical runs within the walls (drop from ceiling junction box to a box within the wall.
5. Do not use for horizontal “daisy chains” within walls.

6. Do not use for homeruns.

J. Outdoors and below grade: Silicone wire nuts.

K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.

L. Fire Alarm Circuits: Lightweight steel Metal-clad cable, Refer to Fire Alarm specification and drawings for details.

M. Class 1 Control Circuits: Type THHN-THWN, in raceway.

M. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not use oil, grease, graphite or similar substances. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway. Pulling of large conductors in raceways shall be done with an approved cable pulling machine. Other methods such as block and tackle to install conductors are not acceptable.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Common Work Results for Electrical."

F. Seal around cables penetrating fire-rated elements according to Division 07 Section "Penetration Firestopping." Provide separate sleeves and/or fire barriers for cable fire wall penetration, unless cable is UL listed for the application.

G. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

H. Metal Clad (MC) Cable Installation Requirements:

1. Provide j–box before running MC cable down with partitions or walls.
2. Overhead MC cable runs shall generally follow building lines to provide a neat and workmanlike installation.
3. SSize j-box to accommodate MC cable splicing.

4. MC cable may be run down directly into panelboards to avoid extra splice into j-box above panelboard as long as concealed. Installed in a neat orderly manner using unistrut or equal to space and hold MC cable in place
5. Strapping to top of hard lid framing acceptable. MC cable runs shall not rest on ceiling structures. Do not support MC cable on hung ceiling or ceiling support wires. Do not support cables or allow contact with mechanical piping. The use of cable ties to support MC Cable is not allowed.
6. Use lock or spring nut fittings.
7. Securely support all MC cable with cable hangers, individual spring steel support clips, steel trapeze hangers, threaded rods or dedicated No. 12 AWG drop wire. Cable supports shall be fastened to concrete slabs, beams, joists or other structural members of the building.
8. MC cable shall be supported every 6 feet and secured within 12 inches from termination.
9. Limit #12 wire homeruns to code voltage drop requirements.
10. Do not make splices in home run circuits, except directly above the panelboard.
11. Cable runs shall be continuous from outlet to outlet.
12. When terminating or splicing at a junction, outlet, or switch box, cut the cable such that 6-inches of free conductors remain for connections or splices.
13. MC cable shall be cut with an armored cable rotary cutter.
14. Insert an anti-short bushing at cable ends to protect conductors from abrasion or use insulated connectors.
15. Bend radius shall be less than 7 times the external diameter of the cable.
16. MC cables passing through fire-rated walls or electrical /telecommunication room walls shall be provided with a UL listed, fire rated penetration assembly.
17. Do not exceed code requirements for total current carrying conductors in multiple MC cable runs bundled together into a single MC cable hanger or strap, unless support device is specifically listed for such purpose. Neutrals shall be counted as current carrying conductors.
18. Maintain a clearance of at least 6 inches from hot water and other high temperature pipes. Maintain at least 12-inches from telecommunication conduits and unshielded twisted-pair telecommunication cables.
19. Installation of MC cable horizontally is not allowed.

3.3 CONNECTIONS

A. Provide steel with insulated throat cable connectors, OZ/Gedney AMC series, Arlington, or equivalent. Die cast or pressure cast fittings are not permitted.

B. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

C. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

D. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 FIELD QUALITY CONTROL (Submit under Section “Electrical Testing”)

A. Test Reports: Prepare a written megger test reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems".

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Data: For the following:

1. Ground rods.
2. Chemical rods.

C. Field Test Reports: Submit under Section “Electrical Testing”. Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

C. Comply with CEC (NFPA 70); for medium-voltage underground construction, comply with IEEE C2.

D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors, Cables, Connectors, and Rods:

a. Boggs, Inc.
b. Chance/Hubbell.
c. Copperweld Corp.
d. Dossert Corp.
e. Erico Inc.; Electrical Products Group.
f. Framatome Connectors/Burndy Electrical.
g. Hastings Fiber Glass Products, Inc.
h. Heary Brothers Lightning Protection Co.
i. Ideal Industries, Inc.
j. ILSCO.
k. Kearney/Cooper Power Systems.
l. Korns: C. C. Korns Co.; Division of Robroy Industries.
m. Lightning Master Corp.
n. Lyncole XIT Grounding.
o. O-Z/Gedney Co.; a business of the EGS Electrical Group.
p. Raco, Inc.; Division of Hubbell.
q. Salisbury: W. H. Salisbury & Co.
r. Superior Grounding Systems, Inc.
s. Thomas & Betts, Electrical.
t. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.”

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

H. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type. facturer's written instructions.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturers recommendation.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Sectional type; copper-clad steel.

1. Size: 3/4 by 120 inches in diameter.

B. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.

C. Test Wells: Provide handholes as specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems."

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

D. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

E. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

F. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with CEC (NFPA 70), Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by CEC (NFPA 70) are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

D. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor.

G. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 2 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors.

3.4 INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

Drive ground rods until tops are 6 inches below finished floor or final grade, unless otherwise indicated. Rod top shall be protected with a driving tool while being driven to protect the top from deformation or other damage.

B. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

G. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

H. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to CEC Using a minimum of 25feet of bare copper conductor not smaller than No. 3/0 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation.

I. Ground bar length will be sized per number of connections x 4” x ¼” copper ground bus shall be installed in electrical rooms. All equipment shall be bonded to the ground bus in addition to CEC required grounds.

J. Made electrodes shall have a measured earth resistance of 10 ohms or less and systems shall be 5 ohms or less.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding

bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

D. Connections at Test Wells: Use compression-type connectors on conductors and make bolted and clamped-type connections between conductors and ground rods.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses.

H. Ground bus connections: Shall be one hole, pressure indented copper cable termination, type burndy hylug, T&B blue, or equal. Install with ½" galvanized or cadmium-plated steel machine bolts with beveled washer each side.

3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Duct Banks: Install a grounding conductor with at least 50 percent ampacity of the largest phase conductor in the duct bank.

B. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 2 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use hard drawn copper not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.7 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

3. A ground resistance test shall be conducted at each new electrical equipment or vault site without the benefit of connections to other sites. That is, all incoming duct bank grounding system conductors shall be disconnected during the test. Grounding electrodes shall be bonded together using the appropriate size grounding electrode conductors and UL listed connections.

3.8 GRADING AND PLANTING (provided by General Contractor)

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 32 Section "Turf and Grasses." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 26 0526

SECTION 26 0529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Seismic restraints for electrical equipment and systems.
3. Construction requirements for concrete bases.

1.2 DEFINITIONS

A. CBC: California Building Code

B. EMT: Electrical metallic tubing.

C. IMC: Intermediate metal conduit.

D. RMC: Rigid metal conduit.

E. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

1.3 SUBMITTALS

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.

1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to the University.
2. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Professional engineer qualification requirements are specified in Division 01 Section "Quality Requirements." Include the following:

1. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the California Building Code

B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3 and in Division 26 Section "Common Work Results for Electrical."

1.5 PROJECT CONDITIONS

A. Project Seismic Zone as Defined in the CBC: Zone 4.

B. Project Seismic Zone Factor as Defined in the CBC: Zone Factor 0.40.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.

1. Manufacturers:

a. Cooper B-Line; a division of Cooper Industries.
b. ERICO International Corporation.
c. Allied Support Systems; Power-Strut Unit.
d. GS Metals Corp.
e. Michigan Hanger Co., Inc.; O-Strut Div.
f. PHD Manufacturing
g. Thomas & Betts Corporation.
h. Unistrut; Tyco International, Ltd.
i. Power-Strut
j. Or equal.

2. Finishes:

a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
b. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-3.
c. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-3.

3. Channel Dimensions: Selected for structural loading and applicable seismic forces.

C. Raceway and Cable Supports: As described in NECA 1.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers:

1) Blue Banger
2) Hilti, Inc.
3) ITW Construction Products.
4) MKT Fastening, LLC.
5) Simpson Strong-Tie Co. Inc.
6) Or equal.

3. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers:

1) Cooper B-Line; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc
3) Hilti, Inc.
4) ITW Construction Products.
5) MKT Fastening, LLC.
6) Powers Fasteners.
7) Or equal.

4. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
5. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
6. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
7. Toggle Bolts: All-steel springhead type.
8. Hanger Rods: Threaded steel.

2.3 SEISMIC-RESTRAINT COMPONENTS

A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to the University.

1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

1. Manufacturers:

a. ISAT Seismic Bracing / CEAS Tomorco Fasteners
b. Loos & Co., Inc.
c. Mason Industries, Inc.
d. Or equal.

2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
3. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod, of design recognized byan agency acceptable to the University**.** Retain both subparagraphs below for projects subject to seismic design requirements; delete if bushing requirements are included in details or charts on Drawings.
4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, and RMC as scheduled in NECA 1, where Table 1 lists maximum spacing less than stated in.. Minimum rod size shall be 1/4 inch in diameter.

C. For individual conduit runs not directly fastened to the structure, use rod hangers.

D. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split galvanized hangers.

E. Do not fasten conduit with wire or perforated pipe straps. Remove wire used for temporary conduit support during construction before conductors are pulled. Do not use ceiling wire to support conduit.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system. Supports should be spaced for maximum deflection of conduit not greater than 1/8".

1. Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to the University.

3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION

A. Comply with NECA 1 for installation requirements, except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, RMCmay be supported by openings through structure members, as permitted in CEC (NFPA 70).

C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.4 CONCRETE BASES

A. Concrete bases shall be provided by Concrete Contractor per Division 03 Section "Cast-in-Place Concrete."

B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and seismic criteria.

C. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.

1. Install dowel rods to connect concrete base to concrete floor. Install dowel rods on 18inch centers minimum around full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Use minimum 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in Place Concrete."

3.5 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS

A. Restraint Cables: Provide slack within maximums recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

E. Provide raceway fixtures and equipment systems with appropriate longitudinal and cross bracing to satisfy Seismic Zone 4 requirements.

3.7 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to electrical equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

END OF SECTION 26 0529

SECTION 26 0533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.
2. Division 07 Section "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
3. Division 26 Section "Hangers and Supports for Electrical Systems" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.
4. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Submit per BIM Execution Plan under section 01 1300 “BIM Specifications”. Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in California Electrical Code (CEC), by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with CEC.

1.5 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 METAL CONDUIT AND TUBING

A. Manufacturers:

1. Arlington.
2. AFC Cable Systems, Inc.
3. Alflex Inc.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
7. LTV Steel Tubular Products Company.
8. Manhattan/CDT/Cole-Flex.
9. O-Z Gedney; Unit of General Signal.
10. Wheatland Tube Co.
11. Or equal.

B. Rigid Steel Conduit: ANSI C80.1.

C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

D. EMT and Fittings: ANSI C80.3.

1. Fittings: Set-screw or compression type.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufactures:

1. Allied.
2. American International
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Arnco Corp.
5. Cantex Inc.
6. Certainteed Corp.; Pipe & Plastics Group.
7. Condux International.
8. ElecSYS, Inc.
9. Electri-Flex Co.
10. Lamson & Sessions; Carlon Electrical Products.
11. Manhattan/CDT/Cole-Flex.
12. RACO; Division of Hubbell, Inc.
13. Spiralduct, Inc./AFC Cable Systems, Inc.
14. Thomas & Betts Corporation.
15. Carlon
16. Or equal.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

2.4 METAL WIREWAYS

A. Manufacturers:

1. Hoffman.
2. Square D.
3. Or equal.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, and other fittings to match and mate with wire ways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with CEC.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

A. Manufacturer:

1. Hoffman.
2. Lamson & Sessions; Carlon Electrical Products.
3. Or equal.

B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

C. Description: PVC plastic extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with CEC.

2.6 SURFACE RACEWAYS

A. Surface Metal Raceways: Two-channel, anodized aluminum, with permanent labels at each receptacle. Top channel: Data; Bottom channel: Power

1. Manufacturers:

a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
b. Thomas & Betts Corporation.
c. Walker Systems, Inc.; Wiremold Company (The).
d. Wiremold Company (The); Electrical Sales Division.

e. Hubbell, Inc.; Wiring Device Division.
f. Or equal.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.

1. Manufacturer:

a. Butler Manufacturing Co.; Walker Division.
b. Enduro Composite Systems.
c. Hubbell, Inc.; Wiring Device Division.
d. Lamson & Sessions; Carlon Electrical Products.
e. Panduit Corp.
f. Walker Systems, Inc.; Wiremold Company (The).
g. Wiremold Company (The); Electrical Sales Division.
h. Or equal.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.7 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
14. Or equal

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Floor Boxes: Plastic or metal.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.8 FACTORY FINISHES

A. Finish: For raceway, enclosures, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel, IMC, EMT.
2. Concealed: Rigid steel, IMC, EMT, RNC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors:

1. Exposed: EMT.
   Concealed: EMT, MC, FMC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: EMT
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

   a. Damp or Wet Locations: NEMA 250, Type 3R, stainless steel

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

E. Do not install aluminum conduits embedded in or in contact with concrete.

3.2 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

E. Conceal MC, FMC, EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

F. Raceways Embedded in Slabs: Shall be placed completely within middle 1/3 of slab thickness where practical and leave at least 1-1/2 inches of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete. Conduits or pipes shall be placed no closer than 3 times the diameter of the largest adjacent conduits/pipes.
3. Conduits or pipe diameter shall be 1” maximum and shall not be placed in more than 2 layers.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor with SP Transition coupling products.
5. For additional requirements, see Structural Drawings.

G. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.

2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

H. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

I. Tighten set screws of thread less fittings with suitable tools.

J. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

K. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections. All stub-up locations will be SP product installation.

N. Flexible Connections: Use flexible conduit or MC for recessed and semi recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

O. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

T. Set floor boxes level. Trim after installation to fit flush with finished floor surface.

U. Install hinged or set screwcover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 0533

SECTION 26 0543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL AND COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Ducts in concrete-encased duct banks.
2. Handholes and handhole accessories.
3. Manholes and manhole accessories.

B. Related Sections include the following:

1. Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding electrodes, counterpoise conductors, clamps and connectors for grounding metallic manhole and hand hole accessories, and testing of grounds.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Manhole and hand hole hardware.
2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
3. Duct-bank materials, including spacers and miscellaneous components.
4. Warning tape.

Shop Drawings: Submit per BIM Execution Plan under section 01 1300 “BIM Specifications”.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied the University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify the University's Representative fourteen days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without University Representative's written permission.

1.6 COORDINATION

A. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to manholes and handholes, and as approved by the University's Representative.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Underground Precast Concrete Structures:

a. Carder Concrete Products.
b. Christy Concrete Products, Inc.
c. Elmhurst-Chicago Stone Co.
d. Jensen Precast.
e. Utility Vault Co.
f. Wausau Concrete Co.
g. Or equal.

2. Frames and Covers:

a. Alhambra Foundry
b. Campbell Foundry Co.
c. East Jordan Iron Works, Inc.

d. McKinley Iron Works, Inc.
e. Neenah Foundry Co.
f. Or equal.

3. Nonmetallic Ducts and Accessories:

a. Arnco Corp.
b. Beck Manufacturing Inc.
c. Cantex, Inc.
d. Certainteed Corp.; Pipe & Plastics Group.
e. ElecSys, Inc.
f. Electri-Flex Co.
g. Lamson & Sessions; Carlon Electrical Products.
h. Manhattan/CDT/Cole-Flex.
i. Spiraduct/AFC Cable Systems, Inc.
j. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 CONDUIT

A. Conduit and fittings are specified in Division 26 Section "Raceways and Boxes for Electrical Systems."

2.3 DUCTS

A. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.4 HANDHOLES

A. Cast-Metal Boxes: Cast aluminum, with outside flanges and recessed, gasketed cover for flush mounting and with nonskid finish and legend on cover. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks.

B. Precast Handholes: Reinforced concrete, monolithically poured walls and bottom, with steel frame and access door assembly as the top of hand hole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be

installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks.

C. Cover Legend: "ELECTRIC."

D. Cover Legend: “COMMUNICATIONS” for communications.

2.5 PRECAST MANHOLES

A. Precast Units: ASTM 478c, with interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Diameter: 48 inches minimum.

C. Design and fabricate structure according to ASTM C 858.

D. Structural Design Loading: ASTM C 857, Class A-16 (AASHTO HS20).

E. Base section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

F. Riser Sections: 4-inch minimum thickness, and lengths to provide required depth Approved by University Representative.

G. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.

H. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches.

I. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

J. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

K. Source Quality Control: Inspect structures according to ASTM C 1037.

2.6 ACCESSORIES

A. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts.

B. Manhole Frames and Covers: Comply with AASHTO loading specified for manhole; Ferrous frame 36 inch clear ID by 6 inch minimum riser with 4-inch-minimum width flange and 36 inch-diameter cover.

1. Provide cast covers with cast-in legend:

a. "LV-ELECTRIC" for duct systems with power wires and cables for systems operating at 600 V and less.
b. "HV-ELECTRIC" for duct systems with medium-voltage cables.
c. "COMMUNICATIONS" for communications, data, and telephone duct systems.

2. Cast iron with cast-in legend as indicated above subsection 1. Milled cover-to-frame bearing surfaces.
3. Manhole Frames and Covers: ASTM A 48; Class 35B gray iron, 36-inch size, machinefinished with flat bearing surfaces.

C. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch- diameter eye and 1by-4-inch bolt.

1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

D. Pulling and Lifting Irons in Floor: 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to reinforced rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

E. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemicalresistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 11/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

F. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

G. Cable Stanchions: Hot-rolled, hot-dip-galvanized, T-section steel; 2-1/4-inch size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

H. Cable Arms: 3/16-inch- thick, hot-rolled, hot-dip-galvanized, steel sheet pressed to channel shape; 12 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any location on cable stanchions.

I. Cable-Support Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

J. Grounding Materials: Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."

K. Warning Tape: Underground-line warning tape specified in Division 26 Section " Identification for Electrical Systems."

L. Add Communications warning tape.

2.7 CONSTRUCTION MATERIALS

A. Seal manhole section joints with sealing compound recommended by the manhole manufacturer.

B. Damp proofing: Comply with Division 07 Section "Bituminous Damp proofing."

C. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

D. Brick for Manhole Chimney: Sewer and manhole brick, ASTM C 32, Grade MS.

E. Concrete: Use 3000-psi- minimum, 28-day compressive strength and 1-inch maximum aggregate size. Concrete and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete." Provide red dye added to concrete during batching for medium voltage.

PART 3 - EXECUTION

3.1 APPLICATION

A. Underground Ducts for Electrical Cables Higher Than 600 V: Type EPC-40-PVC, concrete encased duct bank.

B. Underground Ducts for Telephone Utility Service: Type EPC-40-PVC, direct-buried duct bank, except use Type EPC-80-PVC when crossing roads.

C. Underground Ducts for Communication Circuits: Type EPC-40-PVC, direct-buried duct bank, except use Type EPC-80-PVC when crossing roads.

D. Manholes: Underground precast concrete utility structures.

E. Manholes: Cast-in-place concrete.

3.2 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving" but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Section “Turf and Grasses”.

D. Restore disturbed pavement. Refer to Division 01 Section "Cutting and Patching."

3.3 CONDUIT AND DUCT INSTALLATION

A. Exercise care in excavating, trenching, and working near existing utilities. Locate any existing buried utilities before excavating.

B. Duct banks shall be installed so that the top of the concrete encasement shall be no less than 36 inches below grade or pavement for primary 12KV power, and not less 24 inches below finished grade or pavement for campus-wide communications. As a general rule, depths shall be a minimum of three feet, but not more than six feet.

C. Curves and Bends: Use manufactured 36 inches minimum elbows for stub-ups at equipment, communication pull boxes or enclosures and at building entrances. 24 inches radius is acceptable in areas where 36” cannot be achieved when approved by UCR representative. Use manufactured long sweep bends with a minimum radius of 25 feet, both horizontally and vertically, for MV feeders only. Manufactured long radius bends may be used in runs of 100 feet or less on approval from the University’s representative.

D. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

E. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches o.c. for 5-inch ducts and vary proportionately for other duct sizes. Change from regular spacing to endbell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances.

F. Building Entrances: Make a transition from underground duct to conduit at least 10 feet outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-Encased Ducts: Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.
2. Direct-Buried, Non-encased Ducts at Non-waterproofed Wall Penetrations: Install a Schedule 40, galvanized steel pipe sleeve for each duct. Calk space between conduit and sleeve with duct-sealing compound on both sides for moisture-tight seal.
3. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

G. Concrete-Encased, Nonmetallic Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Duct joints in concrete may be placed side by side horizontally, but shall be staggered at least 6 inches vertically. Joints shall be made in accordance with manufacturer's recommendations for the particular type of duct and coupling selected. In the absence of specific recommendations, plastic duct connections shall be made by brushing a plastic solvent cement on the inside of a plastic coupling fitting and on the outside of duct's ends. The duct and fitting shall then be slipped together with a quick one-quarter turn to set the joint.
3. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between manholes or other terminations in one continuous operation and reinforce only at high traffic areas.
4. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
5. Minimum Clearances between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

6. Depth: Install top of duct bank at least 6 inches below finished grade in no traffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

7. Communications conduit ductbank shall be encased in 2-sack concrete mix slurry with at least 3-inch of cover on all sides. The top surface of concrete cover shall include an orange color dye for future identification.

8. After installation of communications conduit and after the concrete encasement has been cured, the Contractor shall prove all conduits by pulling a mandrel with a diameter ¼ inch smaller than the conduit and 12 inch long through each conduit end-to-end. The Inspector of Record shall be notified 24 hours before this procedure.

H. Direct-Buried Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators not more than 4 feet center-to-center along entire length of duct bank including top pipes.
2. Install expansion fittings as shown on Shop Drawings.
3. Trench Bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches in nominal diameter.
4. Backfill: Install backfill as specified in Division 31 Section "Earth Moving." After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally.
5. Minimum Clearances between Ducts: 3 inches between ducts for like services and 6 inches between power and signal ducts.
6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

I. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.

J. Stub-ups: Use SP products for stub-ups and stub-outs for equipment.

K. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

L. In all Communications conduits, provide three-quarter inch (3/4”) 2500 lb. tensile strength polyester mule tape in each conduit, use NEPTCO or equal.

M. Seal all emply and used communications conduits and/or innerducts with solid and/or split rubber compression plugs, use Jackmoon/Tyco or approved equal.

3.4 MANHOLE AND HANDHOLE INSTALLATION

A. Elevation: Install manholes with rooftop at least 15 inches below finished grade. Install handholes with depth as indicated. Where indicated, cast hand hole cover frame directly into roof of hand hole and set roof surface 1 inch above grade. Place and align precast manholes to provide horizontal tolerance of 2 inches in any direction and vertical alignment with not greater than 1/8 inch maximum tolerance for 6 foot of depth. Completed manhole shall be rigid, true to dimensions and alignment, and shall be watertight.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated. Sumps shall be knocked out at time of installation.

C. Access: Install cast-iron frame and cover.

1. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
2. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

D. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

E. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

F. Grounding: Install ground rod through floor in each structure with top protruding 6 inches above floor. Seal floor opening against water penetration with waterproof nonshrink grout. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

G. Precast Concrete Manhole Installation: comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed

earth. Provide a minimum 6-inch level base of ¾ inch crushed rock under manhole to ensure uniform distribution of soil pressure on floor.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Grounding: Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

D. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.6 CLEANING

A.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

C. Leave a 3/8”-inch minimum polypropylene pull rope in each duct for future use.

END OF SECTION 26 0543

SECTION 26 0544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction of poured concrete walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 SUBMITTALS

A. Product Data

.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
3. Link Seal Model CS Sleeves.

B. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:

   a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Advance Products & Systems, Inc.
   b. CALPICO, Inc.
   c. Metraflex Company (The).
   d. Pipeline Seal and Insulator, Inc.
   e. Proco Products, Inc.
   f. Link Seal

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Poured Concrete Floors, Walls and where specifically required by the listed fire penetration assembly being used.

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

    a. Comply with requirements in Division 07 Section "Joint Sealants."
    b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless formed openings are used. Install sleeves during erection of walls, prior to concrete pour.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

E. Aboveground, Exterior-Wall Penetrations (In Poured Concrete): Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

F. Underground, Exterior-Wall: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals

and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 0544

SECTION 26 0548 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

1.2 DEFINITIONS

A. CBC: California Building Code.

B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.3 SUBMITTALS

A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.

1. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by ICBO Evaluation Service.

B. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs and calculations signed and sealed by a professional engineer.

1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
2. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacing, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
3. Preapproval and Evaluation Documentation: By ICBO Evaluation Service, or an agency approved by University's Representative, showing maximum ratings of restraints and the basis for approval (tests or calculations).

C. Coordination Drawings: Plans and sections drawn to scale and coordinating seismic bracing for electrical components with other systems and equipment, including other seismic restraints, in the vicinity.

1.4 QUALITY ASSURANCE

A. Comply with seismic restraint requirements in California Building Code/Code of Regulations, unless requirements in this Section are more stringent.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in California and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.

C. Testing Agency Qualifications: An independent testing agency, acceptable to University's Representative, with the experience and capability to conduct the testing indicated.

1.5 PROJECT CONDITIONS

A. Project Seismic Parameter: S_{DS} = 1.0g.

B. Seismic Category = D

C. Site Class = D

D. Risk Category as Defined in CBC: III – 1.25 (Importance Factor).

E. Acceleration Factor: SS = 1.5g; S1 = 0.62g

F. For additional criteria, see Structural Drawings.

1.6 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Tomarco / ISAT Seismic Bracing
2. Mason Industries
3. B-Line Systems, Inc.
4. Erico, Inc.
5. Powerstrut.
6. Thomas & Betts Corp.
7. Unistrut Corporation.

8. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.
3. Corrosive Locations: Stainless steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to University’s Representative.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch- thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A 570, GR 33.
2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.

3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
2. Wire Rope Cable: Comply with ASTM 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.

D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install seismic restraints according to applicable codes and regulations and as approved by the University's Representative, unless more stringent requirements are indicated.

3.2 STRUCTURAL ATTACHMENTS

A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses in accordance with the structural engineer of record approval.

B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.

C. Attachments to Existing Concrete: Use expansion anchors.

D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.

E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.

F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.

G. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.3 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panel boards, motor controls, switchboards, switchgear, transformers, fused power-circuit devices, transfer switches, busways, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:

1. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.4 SEISMIC BRACING INSTALLATION

A. Install bracing according to spacing and strengths indicated by approved analysis.

B. Expansion and Contraction: Install to allow for thermal movement of braced components.

C. Cable Braces: Install with maximum cable slack recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in raceways, cables, wire ways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

END OF SECTION 26 0548

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with California Electrical Code (CEC).

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified in other Part 2 articles.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.3 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

2.7 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C.

2.10 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.11 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.12 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Secure nameplates to equipment fronts using screws, rivets or adhesive. Secure nameplate to inside face of recessed panel board doors in finished locations. Use weatherproof adhesive for outdoor installation. Do not use tape for nameplates or legend plates.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations. Use consistent designations throughout project.

1. Based on the University electrical equipment numbering and identification scheme included in this section.

F. Self-Adhesive Identification Products: Clean surfaces before applying.

G. Install nameplates and labels parallel to equipment lines.

H. Color Coded Raceways: Junction Boxes for Fire Alarm System shall be red.

I. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

J. Circuit Identification Labels on Receptacles:

1. Public View Areas (lobbies, atrium, etc.): Stencil circuit information on back of plate.
2. All Other Areas: Engraved or permanently stencil circuit information on front of plate.

K. Conduit installed below grade shall have underground hazard tape (non-adhesive) installed a minimum of 12 inches above the conduit or top layer of conduits in a duct bank. The tape shall be 6 inches wide and 4 millimeters thick yellow polyethylene for low voltage conduits and red for medium voltage conduits. The tape shall be marked “Caution Buried Electric Line” for

low voltage and "Danger High Voltage Line" for medium voltage. Tracer wire shall be used for PVC conduits and non-metallic tape for metallic conduits. The tape shall be installed the entire length of conduit below grade.

L. Color-Coding of Secondary Phase Conductors: Use the following colors for service feeder and branch-circuit phase conductors. Wiring shall be color coded, see Division 26 Section 26 0519, "Low Voltage Electrical Power Conductors and Cables." Low voltage wire markers shall be adhering, preprinted, self-laminating vinyl wrap-around strips. Wire shall be marked with opposite end termination and shall include panel source and circuit numbers. Phasing shall be indicated by colored wire or tape. For other system voltages consult the University:

1. 208/120-V Conductors:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Switch Leg: Pink.
    e. Switch Traveler: Same as Hot Leg.

2. 480/277-V Conductors:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Switch Leg: Purple
    e. Switch Traveler: Same as Hot Leg.

3. Neutral and Ground Conductors:

    a. Neutral: White.
    b. Ground: Green.

4. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

    a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
    b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

M. Power-Circuit Identification: Wrap-around marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch- steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

N. Apply identification to conductors as follows:

1. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
2. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color coding, or cable marking tape.

O. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

P. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 2” high label. Use black lettering on white field. Use white lettering on red field for emergency circuited equipment. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panel boards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Electrical switchgear and switchboards.
4. Emergency system boxes and enclosures.
5. Disconnect switches.
6. Enclosed circuit breakers.
7. Motor starters.
8. Push-button stations.
9. Power transfer equipment.
10. Contactors.
11. Dimmers.

12. Control devices.
13. Transformers.
14. Rectifiers.
15. Power-generating units.
16. Telephone switching equipment.
17. Call system master station.
18. TV/audio-monitoring master station.
19. Fire alarm master station or control panel.
20. Security-monitoring master station or control panel.

Q. Cables in manholes, vaults, and where exiting a building, regardless of size, shall have brass cable identification tags. . Lettering on each tag shall be engraved at least 1/4 inch high. As an alternate, reflective vinyl markers such as Panduit PRL150BY, black legend with yellow background, may be used when applied to heavy vinyl sheeting and attached with tie-wrap at four points.

R. MV Cable Tags shall be connected to cables by non-ferrous cable ties and include the following minimum information:

1. Circuit Identification based on the University's Numbering Scheme
2. Phase of each conductor by letter (A, B, C) 3. Phase by Color Code

   a. A = Yellow Tape – 1 ring
   b. B = Red Tape – 2 rings
   c. C = Blue Tape – 3 rings

4. Both ends termination point of cable segment; e.g., East Sub, Cubicle 3 & MH102.

S. Equipment in manholes, buildings, and substations shall be labeled with engraved nameplates having red background and white letters. The equipment ID plus cable circuit terminations shall be provided. Identify the circuit switching devices and position in addition to cable identification noted above (i.e., SF6-46, way 2; ES-4). Letters shall be ½ inch high minimum on 2 inch by 4 inch plates.

T. An embossed brass tag with manhole number shall be permanently mounted inside the manhole and legible from outside the manhole with the cover removed.

U. The numbering scheme provided by the University accomplishes the following:

1. Establishes a unique identifier for all system components and eliminates possible duplication.

V. Identifies equipment by type as listed in the following table:

MARK OR TAG	DESCRIPTION	EXAMPLE
*	12kV Distribution Circuit	UC-1

FI	Fault Interrupter	FI-01
MH	Manhole	MH-102
OFC	Oil Filled Cutout	OFC-01
OS	Oil Switch	OS-01
PMH	Pad-Mounted Housing	PMH-01
PMS	Pad-Mounted Switch	PMS-02
SF6	Sulfur Hexafluoride Gas Switch	SF6-01
T	Transformer	T-001

* Use the substation name abbreviation for 12kV circuit breaker identification such as UC, CP1, CP2, ES for University Substation, Central Plant 1, Central Plant 2, East Substation.

W. Low Voltage Identification

1. Equipment nameplates shall be engraved three-layer laminated plastic with white background and black letters. Letters shall be ¼" minimum size. Identifications shall match plan designations and based upon the University's numbering scheme.
2. Legend plates for control panels and indicators shall be provided on disconnect and safety switches and indicating lights. The plates shall be die-stamped metal with mounting hole and positioning key.
3. For panel board directories provide the following:

    a. Provide typewritten directories arranged in numerical order showing number of room in which each device is located.
    b. Verify room numbers to be used with the University's representative prior to typing, since room numbers will most likely not be those shown on the drawings.
    c. Mount directories under a clear plastic cover inside each panelboard door.

4. The following low voltage equipment numbering scheme shall be followed:

TYPE	**DESCRIPTION**
DP	208/120V Distribution Panelboard
LP	208/120V Panelboard – Receptacles & Lighting
HDP	480/277V Distribution Panelboard
HLP	480/277 V Panelboard – Lighting
ATS	Automatic Transfer Switch
CB	Circuit Breaker
DS	Disconnect Switch
EDP	Emergency 208/120V Distribution Panelboard
ELP	Emergency 208/120V Panelboard

EHDP	Emergency 480/277V Distribution Panelboard
EMCC	Emergency Motor Control Center
MSB	Main Switchboard
MCC	Motor Control Center
T	Transformer
US	Unit Substation

5. Utilize numbering convention as follows:

   a. First letter or number = floor designation; B = basement, 1, 2, 3, etc. (B).
   b. Subsequent lower case letter = panel number on each floor; a, b, c, etc. (Ba).

      1) Example: Emergency 277/480V Distribution panelboard installed in basement is “EHDP-B”.
      2) Example: second 480/277Vpanelboard installed on third floor for lighting is “HLP-3b”.

X. Telecommunication, Signal Alarm and Control Wiring:

   1. Conductors Terminated or spliced shall be labeled at each end with tape markers.

END OF SECTION 26 0553

SECTION 26 0563 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general requirements for electrical field testing and inspecting. Detailed requirements are specified in each Section containing components that require testing. General requirements include the following:

1. Qualifications of testing agencies and their personnel.
2. Suitability of test equipment.
3. Calibration of test instruments.
4. Coordination requirements for testing and inspecting.
5. Reporting requirements for testing and inspecting.

1.2 QUALITY ASSURANCE

A. Testing Agency Qualifications: As specified in each Section containing electrical testing requirements and in subparagraph and associated subparagraph below.

1. Independent Testing Agencies: Independent of manufacturers, suppliers, and installers of components to be tested or inspected.

a. Testing Agency's Field Supervisor for Power Component Testing: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise onsite testing specified in Division 26 power component Sections.

B. Test Equipment Suitability: Comply with NETA ATS, Section 5.2.

PART 2 - NOT USED

PART 3 - EXECUTION

3.1 GENERAL TESTS AND INSPECTIONS

A. If a group of tests are specified to be performed by an independent testing agency, prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for independent agency testing. Include the following minimum preparations as appropriate:

1. Perform insulation-resistance tests.

2. Perform continuity tests.
3. Perform rotation test (for motors to be tested).
4. Provide a stable source of single-phase, 208/120-V electrical power for test instrumentation at each test location.

5. Testing of breakers 200A and larger.

6. Grounding test.

B. Test and Inspection Reports: In addition to requirements specified elsewhere, report the following:

1. Manufacturer's written testing and inspecting instructions.
2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
3. Tabulation of expected measurement results made before measurements.
4. Tabulation of "as-found" and "as-left" measurement and observation results.

END OF SECTION 26 0563

SECTION 26 0573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies, and the setting of these devices.

1.2 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Qualification Data: For coordination-study specialist.

C. Other Action Submittals:

1. Coordination-study input data, including completed computer program input data sheets.
2. Coordination-study report.
3. Equipment evaluation report.
4. Setting report.

1.3 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

C. Testing Agency Qualifications: Member company of the InterNational Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise testing specified in Part 3.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

F. Comply with IEEE 141 for recommended practice for electric power distribution for industrial plants.

G. Comply with IEEE 320 for special studies procedure.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:

1. SKM Systems Analysis, Inc.
2. OTI.

2.2 COMPUTER SOFTARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.

C. Computer software program shall be capable of plotting and diagramming time-current characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.

1. Optional Features: Arcing faults.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.

3.2 FAULT-CURRENT STUDY

A. Source Impedance: Available short circuit contribution of 11,271 A on primary side of transformer, at 12kV.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operations that

could result in maximum fault conditions.Calculate momentary and interrupting duties on the basis of maximum available fault current.

C. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:

1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
2. Low-Voltage Fuses: IEEE C37.46.
3. Circuit Breakers: IEEE C37.13.

D. Study Report: Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault-current values for 3phase, 2-phase, and phase-to-ground faults.

E. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties.

3.3 COORDINATION STUDY

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical distribution system diagram showing the following:

    a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
    b. Circuit-breaker and fuse-current ratings and types.
    c. Relays and associated power and current transformer ratings and ratios.
    d. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    e. Generator kilovolt amperes, size, voltage, and source impedance.
    f. Cables. Indicate conduit material, sizes of conductors, conductor insulation, and length.
    g. Busway ampacity and impedance.
    h. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.

b. Magnetic inrush current overload capabilities of transformers.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Ratings, types, and settings of utility company's overcurrent protective devices.
e. Special overcurrent protective device settings or types stipulated by utility company.
f. Time-current-characteristic curves of devices indicated to be coordinated.
g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
i. Panel boards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

B. Perform coordination study and prepare a written report using the results of fault-current study and approved computer software program. Comply with IEEE 399.

C. Comply with CEC (NFPA 70) for overcurrent protection of circuit elements and devices.

D. Comply with IEEE 141 recommendations for fault currents and time intervals.

E. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
b. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.

F. Conductor Protection: Protect cables against damage from fault currents according to ICEA P32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.

G. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.
b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between series devices, including power utility company's upstream devices. Show the following specific information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

3. Completed data sheets for setting of overcurrent protective devices.

3.4 OVERCURRENT PROTECTIVE DEVICE SETTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to assist in setting of overcurrent protective devices within equipment.

B. Testing: Perform the following device setting and prepare reports:

1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:

a. Verify that overcurrent protective devices meet parameters used in studies.
b. Adjust devices to values listed in study results.

END OF SECTION 26 0573

SECTION 26 0800 - ELECTRICAL COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section describes the requirements for start-up and commissioning for Division 26 installed work, including but not limited to:

1. Medium voltage distribution system
2. Low voltage distribution system.
3. Emergency power system.
4. Fire alarm system.
5. Lighting system.
6. Lighting control system.
7. Daylight control system.
8. Grounding Equipment and Building Grounding System
9. Lighting Dimming System.
10. Security system.
11. Audio/Visual system.

1.2 REFERENCES

A. National Electrical Testing Association (NETA).

B. American National Standard Institute (ANSI).

C. Institute of Electrical and Electronic Engineers (IEEE).

D. National Electrical Code (NEC).

E. California Electric Code (CEC).

1.3 SUBMITTALS

A. Provide a complete commissioning and training plan submittal for the electrical work.

B. Perform the additional field tests and inspections and prepare test reports not mentioned in this section but required by each section under “Field Quality Control” of Divisions 26, 27 and 28.

1.4 QUALITY ASSURANCE

A. Provide testing equipment and accessories that are free of defects and are certified for use.

B. Provide testing equipment with current calibration labels.

C. Comply with commissioning procedures to ANSI and IEEE guidelines. Incorporate manufacturer's recommend commission procedures for equipment.

1.5 COORDINATION

A. Coordinate commissioning work with the requirements of Section 01 9113 – General Commissioning Requirements.

B. Coordinate commissioning requirements noted in other Division 26 Sections.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment testing work is complete before starting functional performance of power equipment.

B. Verify that operational manuals are complete and been approved by the University's Representative before starting functional performance testing.

C. Inspect equipment and confirm that it is clean and ready for operation. All shipping tags removed, nameplates installed and equipment manuals in place.

3.2 PREPARATION

A. Provide at least one journeyman electrician with tools and equipment necessary to perform functional testing.

B. Provide equipment factory representative for this work when needed.

C. Provide certified testing agency personnel for this work when needed.

D. Provide any necessary temporary power provisions, diesel fuel, equipment and sundries to complete this work.

3.3 POWER COMMISSIONING

A. Perform commissioning work after equipment is installed and system ready for operation.

B. Perform commissioning work in accordance with Power Check Lists and equipment manufacturer's standard procedures and check lists, including but not limited to:

1. Verify test readings, such as:

a. Ground fault protection.

b. Ground resistance.
c. Frequency.
d. Transformer heating.
e. Circuit breaker tripping.

2. Verify calibration of meters:

a. Kwhr meters.
b. Voltmeters.
c. Ammeters.
d. Frequency meters.
e. Circuit Breakers.
f. Fuses.

3. Verify operation of electronic power monitors.
4. Verify readings of remote data systems, such as:

a. Generator alarm.

5. Verify operation of emergency generator system during power loss and in specific:

a. Engine generator start.
b. Automatic transfer of power and bypass.
c. Load demand.
d. Engine cooling.
e. Exhaust.
f. Generator rated capacity (full load test).

6. Verify that total power system is performing time delays outlined in the design intent under part and full load conditions.

3.4 FIRE ALARM SYSTEM COMMISSIONING

A. Perform commissioning work after alarm equipment is installed and system ready for operation.

B. Perform commissioning work in accordance to the manufacturer's standard procedures and check lists, including but not limited to:

1. Verify tests such as:

a. Alarm db.
b. Detectors initiating signal.
c. Trouble lights.

2. Verify settings of:

a. Smoke detectors.
b. Heat detectors.

c. Duct detectors.

3. Verify readings of remote data, such as annunciator panel.
4. Verify operation of system modes:

a. Elevator control.
b. Sprinkler supervisory alarm.
c. Kitchen hood extinguishing system.
d. Kitchen gas solenoid valves.
e. Door hold open/release.

5. Verify that total alarm system is performing to provide conditions as outlined in the design intent.

3.5 CHECKLIST - NORMAL POWER DISTRIBUTION

A. Prior to Functional Performance Test:

1. System in place, including all components indicated, and tested.
2. Connected to campus power system on a permanent basis.
3. Meter wired correctly.
4. Wiring installed in conduits or other raceways.
5. System checked for unwanted grounds, short circuits or open circuits.
6. Ground installed as indicated, including transformers.
7. Equipment connections properly torqued.
8. Equipment, where indicated, on housekeeping pads.
9. Equipment cleaned and shipping blocks removed.
10. Equipment labeled.
11. Boxes and nameplates meet color coding requirements.

B. Personnel to be present or assist as required to Perform Functional Performance Test:

1. Electrical Contractor, sub-contractors and specialty contractors as required.
2. University’s Representative's Project Manager/Representative and/or Inspector of Record (I.O.R.).
3. University’s maintenance staff, as desired.
4. Design Engineer.

C. Functional Performance Test: Demonstrate operation of normal power distribution system per specifications including the following:

1. Activate system by connection to utility power.
2. Demonstrate draw out operation of circuit breakers.
3. Verify voltages and amperes at meters on switchgear.
4. Verify voltages and amperes at switchgear, substations, switchboards, motor control centers, panelboards, and transformers, both primary and secondary.
5. Verify voltages and amperes at mechanical motors and other major pieces of equipment.

D. Verify meter accuracy and connection to the Campus energy system reads correctly.Results:

1. If specified equipment performance is not verified, the Design Builder shall have corrections made and reschedule Functional performance Test as soon as possible after corrective work is completed.

3.6 CHECKLIST - EMERGENCY POWER DISTRIBUTION

A. Prior to Functional Performance Test:
   1. System in place, including all components indicated, and tested.
   2. Facility shall be connected to utility company power system on a permanent basis before emergency checklist is addressed.
   3. Wiring installed in conduits or other raceways.
   4. System check for unwanted grounds, short circuits or open circuits.
   5. Grounds installed as indicated, including transformers.
   6. Ground fault settings made.
   7. Equipment connections properly torqued.
   8. Equipment, where indicated, on housekeeping pads.
   9. Equipment cleaned and shipping blocks removed.
   10. Proper ventilation of electrical rooms.
   11. Electrical rooms free of foreign pipes and ducts.
   12. Fuel oil in fuel storage tank.
   13. Intake and exhaust air, exhaust gas pipe and muffler, fuel oil piping installed.
   14. Equipment labeled.
   15. Boxes and nameplates meet color coding requirements.
   16. Proper phase rotation coordinated between emergency and normal sources.

B. Personnel to be present or assist as required to perform Functional Performance Test:

   1. General Contractor, Mechanical Contractor, Control Contractor, and Electrical Contractor, sub-contractors and specialty contractors as required.
   2. University’s Representative's Project Manager Representative and/or Inspector of Record (IOR).
   3. University’s maintenance staff, as desired.
   4. Design Engineer(s).

C. Functional Performance Test: Demonstrate operation of emergency power distribution system per specifications including the following:

   1. Activate system by manual transfer from utility power.
   2. Demonstrate automatic transfer of power.
   3. Verify voltages and amperes at meters on paralleling gear.
   4. Verify voltages and amperes at paralleling gear switchboards.
   5. Demonstrate synchronization and paralleling automatic and manual.
   6. Demonstrate load shedding and load demand.
   7. Verify generator performance (KW rating).

D. Results:

1. If specified equipment performance is not verified, the Design Builder shall have corrections made and reschedule Functional Performance Test as soon as possible after corrective work is completed.

3.7 CHECKLIST - FIRE ALARM SYSTEM

A. Prior to Functional Performance Test:

1. System in place, including all components indicated, and tested.
2. Connected to emergency power system.
3. Wiring is plenum rated where required.
4. Exposed Areas: Wiring installed in conduit.
5. System checked for grounds or breaks.
6. System connected to elevator control system, sprinkler alarm system and air handling systems.
7. Wiring installed in cable tray, or J-hooks, or bridal spring clips.
8. Cables have color coded identification tags.
9. Boxes and nameplates meet color coding requirements.
10. Verify system has been inspected and given approval by jurisdictional authority.

B. Personnel to be present or assist as required to perform Functional Performance Test:

1. General Contract, Mechanical Contractor, Control Contractor, Fire Alarm Manufacturer's Representative, and Electrical Contractor, sub-contractors and specialty contractors as required.
2. University’s Representative's Project Manager/Representative and/or Inspector of Record (I.O.R.).
3. University’s maintenance staff, as desired.
4. Design Engineer(s).

C. Functional Performance Test: Demonstrate operation of fire alarm system per specifications including the following:

1. Alarm initiating devices including pull stations, ceiling smoke detectors, duct smoke detectors, heat detectors, and sprinkler alarm switches.
2. Air handling unit redirect upon alarm.
3. Verify tie-in and proper system operation with any off-site system monitoring.
4. Fire alarm system annunciator panel.
5. Alarm devices, visual and audible.
6. Central processing unit alphanumeric display and printer.
7. Verify system function upon loss of power.

D. Results:

1. If specified equipment performance is not verified, the Design Builder shall have corrections made and reschedule Functional Performance Test as soon as possible after corrective work is completed.

3.8 GROUNDING/BUILDING GROUNDING SYSTEM

A. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:

1. Conduct fall of potential ground resistance tests per IEEE Standard 81at each test well and at service equipment.
2. Conduct insulation resistance, short circuit, and ground tests of each motor.

3.9 TRAINING

A. At job completion, allow a period of not less than 24 hours for instruction of building operating and maintenance personnel in the use of all systems. Include high voltage safety training where medium voltage equipment is installed. This instruction time (24 hours) is in addition to any instruction time called out in other Division 26 Sections.

B. Instruct all personnel at the same time. Design Builder shall be responsible for coordinating factory representative arrangements.

C. Design Builder shall be responsible for training expenses incurred.

END OF SECTION 26 0800

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Network lighting control system and components:

1. Touch panel controls
2. Lighting management panels
3. Lighting management modules
4. Low voltage wall stations
5. Power interfaces
6. Wired sensors

1.2 RELATED DOCUMENTS

A. Division 26 Section “Wiring Devices”

B. Division 26 Section “Lighting Control Devices”

C. Division Section “Interior Lighting Fixtures”

1.3 SUBMITTALS

A. Product Datasheets (general device descriptions, dimensions, electrical specifications, wiring details, nomenclature).

B. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices).

C. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up.

D. Hardware and Software Operation Manuals.

1.4 PROJECT CLOSEOUT DOCUMENTATION

A. Provide a factory published manual

1. Warranty
2. Technical support contact
3. Electronic manual on manufacturer’s website for free download.

1.5 QUALITY ASSURANCE

A. All steps in sensor manufacturing process shall occur in North America; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.

B. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.

D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.6 PROJECT CONDITIONS

A. Only install equipment after the following site conditions are maintained:

1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C)
2. Relative Humidity less than 90% non-condensing.

B. Standard electrical enclosures are permanently installed.

C. Equipment is protected from dust, debris and moisture.

1.7 WARRANTY

A. Two (2) year 100% parts replacement.

1.8 MAINTENANCE & SUSTAINABILITY

A. Provide free telephone technical support.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable: Acuity Brands Lighting, Inc. – System: nLight by Acuity Controls.

B. Basis of controls design Manufacturer: Acuity Brands, One Lithonia Way, Conyers GA 30012, www.acuitycontrols.com.

C. Substitutions:

1. All substitutions must be submitted in writing for approval at least 14 days prior to bid date.
2. Proposed substitute products must be documented with a line by line compliance review.

2.2 SYSTEMS REQUIREMENTS

A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.

B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

C. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

D. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

E. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

F. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, controls enabled luminaires, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.

G. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

H. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

I. System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.

J. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control schedules and profiles.

K. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

L. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week, utilization of a space. Note: Operating modes should be utilized only in manners consistent with local energy codes.

1. Auto-On / Auto-Off (via occupancy sensors)

    a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
    b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
    c. Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.

2. Manual-On / Auto-Off

    a. Pushing a switch will turn lights on.
    b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

3. Manual-On to Auto-On/Auto-Off

    a. Pushing a switch will turn lights on.
    b. After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
    c. Sequence can be reset via scheduled (ex. daily each morning) events.

4. Auto-to-Override On

    a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
    b. Zone lighting then goes into an override on state for a set amount of time, or until the next time event returns the lighting to an auto-off style of control.
    c. Sequence can be reset via scheduled (ex. daily each morning) events.

5. Manual-to-Override On

    a. Pushing a switch will turn lights on.
    b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
    c. Sequence can be reset via scheduled (ex. daily each morning) events.

6. Auto On / Predictive Off

    a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
    b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

c. Pressing the switch will turn the lights off and a short "exit timer" begins. After the timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.

M. Control software shall enable integration with a BMS via BACnet IP, although a hardware BACnet IP integration solution is also available.

N. System shall provide the option of having pre-terminated plenum rated CAT-5e cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

A. Control module (gateway)

1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet network.
2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
3. Control device shall have three RJ-45 ports for connection to the graphic touch screen, other backbone devices bridges) or directly to lighting control devices (up to 128 per port).
4. Device shall automatically detect all devices downstream of it.
5. Device shall have a standard and astronomical internal time clock.
6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
7. Device shall have a USB port
8. Each control gateway device shall be capable of linking 1500 devices to the management software, with reduced memory version capable of support up to 400 devices.
9. Device shall be capable of using a dedicated static or DHCP assigned IP address.
10. Network Control Gateway device shall be the following nLight model Series or equal:

    a. nGWY2

B. Networked system occupancy sensors

1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.

5. All sensing technologies shall be acoustically passive, meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
7. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
10. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
17. Wall switch sensors shall have optional features for photocell/daylight override, and low temperature/high humidity operation.
18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
19. Wall switch sensors shall be the following nLight model numbers, with device color and optional features as specified or equal:

    a. nWSX LV DX (PIR, No Relay, Raise/Lower Dim Ctrl)
    b. nWSX PDT LV DX (Dual Tech, No Relay,Raise/Lower Dim Ctrl)

20. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available or equal.
21. Sensors shall be the following nLight model numbers, with device options or equal.

Model # Series	Occupancy Poles	# of Relays	Lens Type	Detection Technology
nCM PDT 9	1	-	Standard	Dual
nCM(B) 10	1	-	Extended	PIR
nCM 6	1	-	Extended	PIR

C. Network system daylight (photocell and/or dimming) sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Photocell and dimming sensors shall be equipped with an automatic override for100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
5. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
6. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
7. Sensor shall be the following nLight model numbers, with device options as specified or equal:

    a. nCM ADCX (remote automatic dimming control photocell).

D. D.Networked System Power (Relay) Packs

1. Power Packs shall incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 or 277 VAC be plenum rated, and provide Class 2 power to the system.
3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into

adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
7. Power Packs and Power Supplies shall be available that are WiFi enabled.
8. Power Packs (Secondary) shall be available that provide up to 16 Amp switching of all lighting load types.
9. Power Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
12. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
13. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
14. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
15. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
16. Power (Secondary) Packs shall be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.
17. Power (Relay) Packs and Supplies shall be the following nLight model numbers or equal:

    a. nPP16 D (Power Pack w/ 16A relay and 0-10VDC dimming output)
    b. nPP16 D ER UL924 Listed Secondary Pack w/ 16A relay and 0-10VDC dimming output for switching/dimming emergency power circuits)
    c. nSP5 PCD 2W (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)
    d. nSP5 PCD MLV (Secondary Pack w/ 5A relay and magnetic low voltage dimming output)
    e. nSP5 PCD ELV 120 (Secondary Pack w/ 4A relay and electronic low voltage dimming output)
    f. nPP20 PL (Secondary Pack w/ 20A relay for general purpose receptacle load)

E. Networked Auxiliary Input / Output (I/O) Devices

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.
2. Devices shall have two RJ-45 ports
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.

5. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
6. Specific I/O devices shall sense state of low voltage outdoor photocells.
7. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
8. Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).
9. Auxiliary Input/Output Devices shall be the following nLight model numbers:

    a. nIO D (I/O device with 0-10 dimming output)
    b. nIO 1S or nIO RLX (I/O device with contact closure or 0-10VDC dimming input)
    c. nIO NLI (Input device for detecting state of low voltage outdoor photocell; sold in nIO PC KIT only)
    d. nIO X (Interface device for communicating with RS-232 enabled AVTouch Screens.

F. Networked LED Luminaires

1. Networked LED luminaire shall have a mechanically integrated control device.
2. Networked LED luminaire shall have two RJ-45 ports available (via control device directly or incorporated RJ-45 splitter).
3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers).
4. Networked LED luminaire shall provide low voltage power to other networked control devices (excluding EMG versions).
5. System shall be able to turn on/off specific LED luminaires without using a relay, if LED driver supports “sleep mode.”
6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).
8. Integrated control devices shall be the following nLight model series:

    a. nIO LEDG (ER)
    b. nIO EZ PH (ER)
    c. nPS 80 EZ (ER)
    d. nEPS 60 IO EZ
    e. nEIO EZ LC (ER)

G. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
3. All devices shall have two RJ-45 ports.
4. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.

5. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
6. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
7. Devices with mechanical push-buttons shall be made available with custom button labeling.
8. Devices with a single "on" button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
9. Wall switches & dimmers shall be the following nLight model numbers, with device options as specified or equal:

    a. nPODM DX (single on/off, single dimming raise/lower, push-buttons, LED user feedback).
    b. nPODM 2P DX (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback).
    c. nPODM 4P DX (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback).

H. Networked System Graphic Wall Station

1. Device shall have a 3.5" full color touch screen for selecting up to 16 programmable lighting control preset scenes or acting as up to 16 on/off/dim control switches.
2. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
3. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
4. Device shall enable user supplied .jpg screen saver image to be uploaded.
5. Device shall surface mount to single-gang switch box.
6. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
7. Device shall have a micro-USB style connector for local computer connectivity.
8. Device shall have two RJ-45 ports for communication.
9. Device shall be the following nLight model number or equal:

    a. nPOD GFX

I. Communication Bridges

1. Device shall surface mount to a standard 4" x 4" square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be capable of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

6. Communication Bridge devices shall be the following nLight model numbers or equal:

a. nBRG 8 (8 Ports)

2.4 LIGHTING CONTROL PROFILES

A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.

C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

D. Specific device parameters (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

E. All lighting control profiles shall be stored on the network control gateway device, with a system backup on the software's host server.

F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.

I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5 MANAGEMENT SOFTWARE

A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software.

B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).

C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.

D. A printable network inventory report shall be available via the software.

E. A printable report detailing all system profiles shall be available via the software.

F. Software shall require all users to login with a User Name and Password.

G. Software shall provide at least three permission levels for users.

H. All sensitive stored information and privileged communication by the software shall be encrypted.

I. All device firmware and system software updates must be available for automatic download and installation via the internet.

J. Software shall be capable of managing systems interconnected via a WAN (wide area network).

2.6 BMS COMPATIBILITY

A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software.

2.7 START-UP & SUPPORT FEATURES

A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.

B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.

D. All system devices shall be capable of being given user defined names.

E. All devices within the network shall be able to have their firmware upgraded remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.

F. All sensor devices shall have the ability to detect improper communication wiring and blink it’s LED in a specific cadence as to alert installation/startup personnel.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETING

A. A factory authorized manufacturer’s representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall

schedule the pre-installation site visit after receipt of approved submittals to review the following:

1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
2. Review the specifications for low voltage control wiring and termination.
3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
4. Discuss requirements for integration with other trades.

3.2 INSTALLATION AND SERVICES

A. Install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.

B. Install all room/area devices using Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, test each field-terminated cable following installation, and shall supply the lighting controls manufactuerer with test results. Install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer’s specifications. Route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

C. Install the work of this Section in accordance with manufacturer’s printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.

D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.

1. Adjust time delay so that controlled area remains lighted while occupied.

E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

3.3 FACTORY SERVICES

A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.

B. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.4 COMMISSIONING OF SUPPORT SERVICES

A. On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.

B. The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.

3.5 OPTIONAL ACCEPTANCE TESTING SUPPORT SERVICES

A. A certified lighting controls acceptance test technician (CLCATT) must verify the installation of the lighting control system. Include an extra day of factory technician's time to assist the CLCATT review the functionality and settings of the lighting control hardware per the requirements in the California State forms. Create and complete any forms required for the commissioning process.

END OF SECTION 26 0923

SECTION 26 0926 - LIGHTING CONTROL PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system. All Labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete system for the control of lighting and other equipment as indicated on the plans, detailed in the manufacturer submittal and as further defined herein. Contractor is solely responsible to verify quantity, installation locations and wiring requirements for this project. Specific manufacturer's catalog numbers, when listed in this section are for reference only. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.

B. The system shall include but not be limited by the following list: Pre-wired, microprocessor controlled relay or dimming panels with latching relays controlled via a complete list of communication based accessories including digital switches, digital photocells, digital SmartBreaker panelboards, Digital Time Clock (DTC) and interface cards to dimming systems, building automation systems, thermostats, and other devices. The type of lighting control equipment and wiring specified in this section is covered by the description: Microprocessor Controlled Digital Lighting Control system with RS 485 Bus communications. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring. They are not the work of this section.

C. SmartBreaker panel boards shall operate as if each breaker were a relay in the lighting control system. All references in this spec to the operation of relays shall apply equally to the solenoid operated thermal magnetic breakers within SmartBreaker panel boards.

1.3 SUBMITTALS

A. Section 16010 – Shop Drawing Requirements. Contractor may submit with Section "Lighting Control Devices" submittal for a complete lighting control system.

B. Shop Drawings: Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, DTC, photocells and other interfaces. Shop drawings shall indicate exact location of each device or a RFI to confirm

location. Plans are diagrammatical. Verify all lighting control material requirements from approved shop drawings. "Cut Sheet" submittal not acceptable.

C. Product Data: Submit for approval manufacturer's data on the specific lighting control system and components. Submittal shall be electronic format with hard copy available. To prevent departures from approved system operation, electronic files submitted shall be able to be directly downloaded to the specified system at manufacturer facility. Submit a complete bill of materials with part numbers, description and voltage specifications.

D. Manufacturer shall provide free software that can be used to specify the system, detail all programming and generate a single line in a format that can be dropped into industry standard CAD packages.

E. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component if it differs from that illustrated in the riser diagram in these specifications. Submittals that show typical riser diagrams are not acceptable.

1.4 QUALITY ASSURANCE

A. Products shall be manufactured by Lighting Control & Design, Los Angeles, CA, 800.345.4448 or approved equal. Such firms shall be regularly engaged in manufacturing of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Any product other than those listed in this specification must be pre-approved a minimum of two weeks before bid time. No exceptions.

B. Control wiring shall be in accordance with the California Electrical Code (CEC) requirements for Class 2 remote control systems, Article 725 and manufacturer specification.

C. A licensed electrician shall functionally test each system component after installation, verify proper operation and confirm that all relay and dimming panels and switch wiring conform to the wiring documentation. Contractor is required to phone LC&D a minimum of 7 days before turnover for system checkout. At time of LC&D contact, all components including phone line to modem must be installed, powered and operational.

D. Comply with CEC and all local and state codes as applicable to electrical wiring work.

E. Lighting control panels shall be UL 916 Listed. LCPs controlling emergency circuits shall be ETL listed to UL 924. Relay panels shall also be listed to comply with CSA C22.2#205 Emergency source circuits controlled in normal operation by a relay panel shall fully comply with NEC 700-9(b). Electrical contractor is responsible for verifying compliance.

F. The lighting control system shall be listed, approved and comply as required with all national, state and local energy codes to include but not limited to California Title 24 and ASHRAE 90.1-2004.

1.5 MAINTENANCE MATERIALS

A. Division 1 - Execution Requirements:

B. Provide spare relays per LCP, up to the maximum capacity of the LCP.

C. Provide CD version of manufacturers operating software to include graphical interface software.

D. Provide set of as-built and operating manuals.

1.6 SUBSTITUTIONS

A. Where substitute products are proposed, comply with provisions in Division 01 under "Product Substitution" Article.

1.7 SYSTEM DESCRIPTION

A. The lighting control system is a networked system that communicates via RS485. The system must be able to communicate with fully digital centralized relay panels, small distributed relay panels (Available with 0-10Volt dimming outputs), (also called Micro Panels), Fully distributed fixture level control by bus connected relays or dimmers, (also called X-Point) smart breaker panels, digital switches, photocells, various interfaces and operational software. The intent of the specification is to integrate all lighting control into one system. Distributed lighting control shall be provided using networked micro relay panels or bus connected fixture level control (X Point.). Lighting control system shall include all hardware and software. Software shall be resident within the lighting control system. System shall provide local access to all programming functions at the master LCP and remote access to all programming functions via dial up modem and through any standard computer workstation. Lighting control system shall have the capability to be remotely controlled via the internet or building wide Ethernet LAN. Desktop computers are not part of this section and will be provided by others.

B. System software shall provide real time status of each relay, each zone and each group.

C. Lighting control system shall be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go off-line all system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on line PC or server for normal operation are not acceptable

D. All devices shall be pre-addressed at the factory. If required by the client the system may be specified without pre-addressing and simple software is to be provided to simplify addressing in place. This particularly applies to fixture level control where controls may be factory mounted on the fixture in advance to speed installation.

E. All programs, schedules, time of day, etc, shall be held in non-volatile memory for an indefinite time exceeding 10 years in the event of power failure. At restoration of power, lighting control system shall implement programs required by current time and date. Time of day shall be battery backed for at least 10 years.

F. System shall be capable of warning of an impending off sweep by flashing lights Off/On once or twice (programmable) by relay or by zone prior to the lights being turned off. The warning

interval times between the flash and the final lights off signal shall be definable for each zone. Additionally an audible signal shall be able to be programmed that gives a mild note on the first flash and a more insistent signal on the second one. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and not exceed 2-hours.

G. The system shall be capable of implementing On commands, Off commands, Raise (dimming) commands, Lower (dimming) commands for any relay, group or zone by means of digital wall switches, contact closure switches, time clock schedules including offsets from dusk and dawn by up to 10 hours, photocell, pc software or other devices connected to programmable inputs in a lighting control panel.

H. The lighting control system shall provide the ability to control each relay and each relay group per this specifications requirement. All programming and scheduling shall be able to be done locally at the master LCP and remotely via dial up modem or via the Internet. Remote connection to the lighting control system shall provide real time control and real time feedback.

I. Micro relay panels shall be capable of taking inputs from contact closure switches and outputting up to 8 independent 0v to 10v dimming signals. All micro relay panels and all devices connected to micro relay panels (switches, photocells and occupancy sensors, etc) shall be wired per lighting control manufacturers instructions.

J. X Point relay or dimming modules shall be fed from an X Point router that sits on the GR 2400 Bus in the manner of a relay panel. Individual modules are fed from this panel on a separate bus. Each router may feed two strings of up to 64 modules on a 2000ft string. Each Module may be a single relay, a dual relay or a dimming (0-10Volt) module. Relays in the modules are to be capable of being separately controlled in the same manner as an individual relay or dimmer in a relay or dimmer panel. Additionally multiple relays may be collected together to act together as a single multi-pole load or dimmer for ease of programming. Graphical software shall be available that does these assignments and reassignments in a straightforward and logical manner. Relays shall have the same specifications as laid out in 2.1.3. Modules with reduced current ratings may be supplied with Quick Connect connectors for more rapid installation.

PART 2 - PRODUCTS

2.1 MATERIAL AND COMPONENTS

A. Relay Panels:

1. All LCP’s shall be in NEMA 1 rated enclosure with screw cover or hinged Locking door. Other NEMA rated types optional.
2. A barrier shall separate the high voltage and low voltage compartments of the panel and separate 120v and 277v.
3. LCP input power shall be capable of accepting 120v or 277v without rewiring.
4. Control electronics in the low voltage section shall be capable of driving 2 to 48 relays, control any individual or group of relays, provide individual relay overrides, provide a master override for each panel, store all programming in non-volatile memory, after power is restored return system to the correct state for time of day, provide

programmable dual blink warn timers for each relay or zone of relays, and be able to control Normally Open Latching (NOL) or Normally Closed Latching (NCL) relays.

5. Lighting control system shall be digital and consist of a Master LCP, Remote LCPs, Micro LCPs with up to 8 individual relays, X Point Router and associated relays or dimmers emulating standard or Micro LCPs, digital switches, digital interface cards and if required, SmartBreaker panelboards. All system components shall connect and be controlled via Category 5, 4 twisted pair cable with RJ45 connectors, providing real time two-way communication with each system component. All Micro LCP's shall provide multiple inputs for photocells and occupancy sensors. Analog systems are not acceptable.

B. Micro Relay Panels

1. Micro relay panels shall have from 2 to 8 relays and shall control all lighting in the designated area indicated on the plans and be part of the lighting control network. Each micro relay panel shall provide minimum 300ma at 12/24vdc for powering occupancy sensors. Micro relay panels that require a separate occupancy sensor power pack are not acceptable.
2. Micro relay panel shall provide a minimum of 4-programmable photocell inputs, a minimum of 8-programmable occupancy sensor contact closure inputs. This requirement is to insure integration of entire lighting system into one networked, lighting control system.
3. Micro relay panels shall be capable of outputting a minimum of 4 and up to 8 independent 0v to 10v dimming signals, one independent dimming signal per relay for each of 8 relays. In order to maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim, fade up rate, fade down rate, time delay and enable/disable masking. All photocell settings must be remotely accessible. Systems providing On, Off with Time Delay only, and system that do not provide remote access are not acceptable.
4. MicroPanels shall have built in capability to take commands from a fully compatible wireless switch. Wireless switch shall contain no battery; have 32-bit unique ID and a minimum 90-foot range line of sight.

C. Standard Output Relays

1. UL Listed 30 Amp @ 277VAC Ballast and HID and 20 Amp Tungsten at 120 Vac.
2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #8AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable. Relays to be rated for 250,000 operations minimum at a full 30 lighting load. Standard relay shall default to closed at normal power loss, Normally Closed Latching (NCL).
3. Optional relay types available shall include: Normally Open Latching (NOL) relay rated for 250,000 operations, a 600v 2-pole NO and NC and a Single Pole, Double Throw (SPDT) relay.

D. Low Voltage Switches

1. All switches shall be digital and communicate via RS 485. Contact closure style switches, except as specified for connection to the micro relay panel programmable contact closure inputs, shall not be acceptable. The programming for a digital switch shall reside in the switch itself, via double EPROM memory. Any digital switch button function shall be

able to be changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.

2. Digital low voltage switch shall be a device that sits on the lighting control system bus. Digital switch shall connect to the system bus using the same cable and connection method required for relay panels. Each button shall be capable of being programmed for On only, Off only, Mix (Some on some off), On/Off (toggle), Raise (Dim up) and Lower (Dim down). Further each button shall be able to be enabled or disabled over the bus. An audible alarm shall be available on all switches that can be programmed to beep on button push or with warning light blinks.
3. Keyed switches shall be similarly programmable and connect to the lighting control system bus.

E. Wireless Switches-System shall have the capability to accept inputs from 32-bit unique ID wireless switches. Wireless switches shall have no battery and be capable of On, Off, Raise and Lower commands. Wireless switches shall have a minimum 90 foot line of sight range.

F. DTC - Digital Electronic Time Clock

1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept modem (RS232) inputs.
2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
3. The DTC shall be capable of controlling digital devices at up to 127 addresses on a single bus and capable of interfacing digitally with other buses using manufacturer supplied interface cards.
4. The DTC shall accept control locally using built in button prompts and use of an 8 line 21-space display or from a computer or modem via an on-board RS 232 port. All commands shall be in plain English. The DTC shall be run from non-volatile memory so that all system programming is retained indefinitely and time of day is battery backed for up to 10 years.
5. Unity™ lighting control software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone. System shall be capable of running optional Unity GX lighting control software. Unity GX shall provide for importing vector based graphics and a simple interface that allows users or a factory programmer to overlay color “controls” that are associated with relays or collections of relays. Clicking on the overlays changes the color and the status of the relays for visual display of large systems.
6. System shall come with a pre-Installed modem that allows for remote programming from any location using a PC and free remote control software.
7. DTC shall provide system wide timed overrides. Any relay, group or zone that is overridden ON, before or after hours, shall automatically be swept OFF by the DTC a maximum of 2 hours later.

G. Photocell: Photocells to be mounted in location as required for maximum system efficiency operation. Photocells used for exterior lights shall provide multiple trip points from (1) roof mounted unit. All trip points shall be able to be changed remotely via Internet or dial up modem. Photocells requiring manual trip point adjustment are not acceptable. Photocell used

for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up, fade-down, etc. All settings shall be remotely accessible and adjustable. Systems providing local adjustment only are not acceptable. Photocells to be certified to comply with the current energy code covering this project at time of submittal of plans for building permit.

H. Interfaces: For future expansion capability, systems are to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans.

1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card on runs over 200ft.
2. Uplink Interface card that allows a single bus to be part of a greater system connected together by a Back Bone Bus. The back Bone bus requires a server for the Modem and Ethernet connections to such a large system.
3. An interface card (T-LINK) that allows the DTC to control up to 32 digital XCI brand thermostats. Programming of thermostats is to be capable of being done locally (at the DTC) or remotely, via modem, Internet or Ethernet.
4. When Unity GX software is specified full graphic pages shall be designed to the owner's specifications. Owner is to provide to manufacturer all necessary files and criteria.
5. Direct digital interface to SmartBreaker panelboards. Relay panel and SmartBreaker panelboard circuits shall appear on the system software as similar, yet distinct, items and maintain all functions and features of the system software.
6. Direct digital interface to building automation systems using DDC protocols such as BACnet, Metasys (N2) and ModBus that accept on/off commands, time schedules and report status of all relays in all panels in real time. Interface cards shall "self populate" each individual relay and each group to the BAS. All BAS system programming required shall be the responsibility of the BAS system provider.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Mount relay control cabinets adjacent to respective lighting panel board. Cabinet shall be surface or flush mount, per plans. Wiring between relay control cabinets and panelboards shall be in accordance with local codes and acceptable industry standards. Under no circumstances will any extra payment be authorized for the Contractor due to Contractor's lack of knowledge or understanding of any and all prevailing codes or specified manufacturer's installation requirements. Neatly lace and rack wiring in cabinets. During construction process, protect all interior components of each relay panel and each digital switch from dust and debris. Any damage done to electronic components due to failure to protect them shall be the sole responsibility of the installing contractor.

B. Switches: Provide outlet boxes, single or multi-gang, as shown on the plans for the low voltage digital switches. Mount switches as per plans. Supply faceplates per plans and specifications. EC is specifically responsible to supply and install the required low voltage cable, Category 5, 4 twisted pair, with RJ45 connectors (commonly referred to as Cat 5 patch cable) between all switches and panels. Field-test all Cat 5 patch cable with a recognized cable tester. All low voltage wire to be run in conduit, per local codes.

C. Manufacturer to provide on all systems of more than 2 panels a crimping kit with sufficient approved EZ Brand RJ 45 connectors to populate the whole system. A simple manual that shows all the pitfalls of crimping RJ 45s and how to do it right must be both provided and read by the installing contractor.

D. Wiring:

1. Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
2. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.
3. Place manufacturer supplied "terminators" at each end of the system bus per manufacturer's instructions.
4. Use Category 5 patch cable for all system low voltage connections. Additional conductors may be required to compensate for voltage drop with specific system designs. Contact LC&D or refer to the GR2400 manual for further information. Use shielded cable for dry contact inputs on runs over 200ft.
5. Do not exceed 4000ft-wire length for the system bus.
6. All items on the bus shall be connected in sequence (daisy chained). Star and spur topologies are not acceptable.
7. Make all necessary wiring connections to external devices and equipment, to include photocell. EC to wire per manufacturer instructions.

3.2 INSTALLATION AND SET-UP

A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel in low-voltage areas. Refer to manufacturer's plans and approved shop drawings for location of line and low-voltage areas. This is especially applicable in jobs where back boxes are shipped in advance. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.

B. For approved contact closure switches, use #18 AWG stranded conductors. For all other digital switches, provide wiring required by system manufacturer.

C. For classroom digital switches provide wiring required by system manufacturer

D. Test all low voltage cable for integrity and proper operation prior to turn over. Verify with system manufacturer all wiring and testing requirements.

E. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, commissioning of the lighting control system and Owner instruction includes:

1. Confirmation of entire system operation and communication to each device.
2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors
3. Confirmation of system Programming, photocell settings, override settings, etc.
4. Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.

F. Panels shall be located so that they are readily accessible and not exposed to physical damage.

G. Panel locations shall be furnished with sufficient working space around panels to comply with the National Electric Electrical Code.

H. Panels shall be securely fastened to the mounting surface by at least 4 points.

I. Unused openings in the cabinet shall be effectively closed.

J. Cabinets shall be grounded as specified in the National Electrical Code.

K. Lugs shall be suitable and listed for installation with the conductor being connected.

L. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.

M. Maintain the required bending radius of conductors inside cabinets.

N. Clean cabinets of foreign material such as cement, plaster and paint.

O. Distribute and arrange conductors neatly in the wiring gutters.

P. Follow the manufacturer's torque values to tighten lugs.

Q. Before energizing a panel, the following steps shall be taken:

1. Retighten relay connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
2. Remove shipping blocks from component devices and the panel interior.
3. Remove debris from panel interior.

R. Follow manufacturer’s instructions for installation and all low voltage wiring.

S. Service and Operation Manuals:

1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.
2. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built color coding used on cables. Programming forms of systems shall be submitted with complete information.
3. Comply with energy code lighting control system “Acceptance Requirements”. Acceptance tests are used to verify that lighting controls were installed and calibrated correctly. These tests may require that a responsible party certify that controls are installed and calibrated properly. This is the installing contractor’s responsibility. Verify requirements with building authority.

3.3 DOCUMENTATION

A. Each relay shall have an identification label indicating the originating branch circuit number and panelboard name as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.

B. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to owner, copies placed inside the door of each LCP.

3.4 SERVICE AND SUPPORT

A. Telephone factory support shall be available at no additional cost to the Owner both during and after the warranty period. Factory to pre-program the lighting control system per plans and approved submittal, to the extent data is available. The specified manufacturer, at no added cost, shall provide additional remote programming via modem as required by the Owner for as long as a phone line is available for the life of the system. Upon request manufacturer to provide remote dial up software at no added cost to system owner. No exceptions.

B. Provide a factory technician for on-site training of the owners' representatives and maintenance personnel.

3.5 CLEANING

A. Division 1 - Execution Requirements: Final cleaning.

B. Clean photocell lens as recommended by manufacturer.

C. Clean all switch faceplates.

END OF SECTION 26 0926

SECTION 26 1200 - MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of transformers with medium-voltage primaries:

1. Pad-mounted, liquid-filled transformers.

B. Related Sections include the following:

1. Division 26 Section "Seismic Restraint For Electrical Systems" for requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformer and accessories.

1.6 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the California Electrical Code (CEC), by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C2.

D. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.

E. Comply with the CEC.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Asea Brown Boveri (ABB)
2. Cooper Industries; Cooper Power Systems Division.
3. Cutler-Hammer.
4. GE Electrical Distribution & Control.
5. Siemens Energy & Automation, Inc.
6. Square D; Schneider Electric.
7. Or equal.

2.2 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

A. Description: ANSI C57.12.13, ANSI C57.12.26, IEEE C57.12.00, pad-mounted, 2-winding transformers. Stainless steel tank base.

B. Insulating Liquid: Envirotemp FR3 less flammable fluid, dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 1816. Liquid shall be biodegradable and nontoxic.

C. The transformer(s) shall be rated as shown on drawings. Primary voltage 12.47 kV, delta . Secondary voltage 480V, 3-phase, 3-wire, 60 Hz.

D. Basic Impulse Level: 95kV.

E. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.

F. High-Voltage Switch: 200 A, make-and-latch rating of 10-kA RMS, symmetrical, arranged for radial feed with 3-phase, 2-position, gang-operated, load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.

G. Primary Fuses: 150-kV fuse assembly with fuses complying with IEEE C37.47. Rating of current-limiting fuses shall be 50-kA RMS at 15kV system.
1. Internal liquid-immersed cartridge fuses.

H. Surge Arresters: Distribution class, one for each primary phase; complying with IEEE C62.11 and NEMA LA 1; support from tank wall within high-voltage compartment. Transformers shall have three arresters for radial-feed circuits.

I. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:

1. Bushing-Well Inserts: One for each high-voltage bushing well.
2. Surge Arresters: Dead-front, elbow-type, metal-oxide-varistor units.
3. Parking Stands: One for each high-voltage bushing well.
4. Portable Insulated Bushings: Arranged for parking insulated, high-voltage, load-break cable terminators; one for each primary feeder conductor terminating at transformer.

J. Accessories:

1. Drain Valve: 1 inch, with sampling device.
2. Dial-type thermometer.
3. Liquid-level gage.
4. Pressure-vacuum gage.
5. Pressure Relief Device: Self-sealing with an indicator.
6. Mounting provisions for low-voltage current transformers.
7. Mounting provisions for low-voltage potential transformers.

2.3 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.4 SOURCE QUALITY CONTROL

A. Perform electrical acceptance testing prior to energization.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.

B. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with mounting and anchoring per manufacturer’s or structural engineer of record recommendations.

B. Equipment Mounting: Install transformers on concrete bases complying with Division 26 Section "Common Work Results for Electrical."

C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and the CEC.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

B. Test Reports: Prepare written reports to record the following:

1. Test results that comply with requirements.

END OF SECTION 26 1200

SECTION 26 1314 - MEDIUM VOLTAGE 4-WAY SELECTOR SWITCH

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes 15kV, 4-way, pad-mounted air switch for outdoor application.

B. Related sections include the following:

1. Division 26 Section “Grounding and Bonding” for requirements of grounding of equipment.
2. Division 26 Section “Seismic Controls for Electrical Work” for seismic anchorage and bracing at the factory and in the field.
3. Division 26 Section “Medium Voltage Cable” for requirements of terminating cables for incoming and outgoing cables.
4. Division 26 Section “Electrical Identification” for requirements of identifications of switch and cables.

1.3 STANDARDS

A. Institute of Electrical and Electronic Engineers, Inc (IEEE) Publication:

1. 386-85 Separable Insulated Connectors for Power Distribution Systems above 600 V

1.4 ACTION SUBMITTALS

A. Manufacturer’s Data: Provide for the following items:

1. Switch assembly
2. Enclosure.

B. Shop Drawings:

1. Equipment dimensional data and line-up drawings, including front, top and side views and section through assembly showing positions and locations of incoming cables, circuits, landing lugs, junction bars and bar supports.

1.5 INFORMATIONAL SUBMITTALS

A. Operation and Maintenance Manuals: Provide instruction manuals during the installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Federal Pacific

B. Cooper/Eaton

C. S&C Electric Company

D. Approved equivalent.

2.2 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and of high quality to give long life and reliable operation. All equipment shall be modern in design and shall not have been in prior service except as required by factory tests.

2.3 AIR-INSULATED SWITCHES

A. General: The switch shall have the following ratings:

1. Maximum circuit voltage to ground – 15.kV.
2. Impulse Level (BIL) – 95kV.
3. 1 Minute AC Withstand – 36.4 kV.
4. Continuous Current and Load Interrupting – 600 Amps.
5. Symmetric Interrupting Rating – 25 kA.
6. Asymmetric Interrupting Rating 40 kA.

B. Enclosure

1. The enclosure shall be weatherproof and suitable for pad mount application. Enclosure shall painted with green finish.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall conform to requirements of CEC and to manufacturer’s instructions.

B. Prior to submitting shop drawings and releasing order for equipment, Contractor shall verify dimensions of the available space where equipment will be installed.

C. Anchor according to requirements shown on Structural drawings.

3.2 CABLE CONNECTIONS:

A. Terminations of insulated power cables shall be made using materials and methods specified in specifications for medium voltage cables.

3.3 FIELD QUALITY CONTROL:

A. Test and inspect according to Division 26 Section “Acceptance Testing for Electrical Systems.”

3.4 WARRANTY

A. The complete assembly shall have a minimum two (2) years warranty. Warranty shall include labor and parts required to repair or replace the switch on site.

END OF SECTION 26 1314

SECTION 26 2200 – LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.
2. Control and signal transformers.

1.2 SUBMITTALS

A. Product Data Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Wiring and connection diagrams.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to the University, and marked for intended use.

B. Comply with IEEE C 57.12.91.

C. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP 2.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Electric Corporation; Power Distribution Products Division.
2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
3. Computer Power Inc.
4. Controlled Power Co.
5. Cutler-Hammer.
6. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
7. GE Electrical Distribution & Control.
8. Hammond Co.; Matra Electric, Inc.
9. Jefferson Electric, Inc.
10. Micron Industries Corp.
11. Siemens Energy & Automation, Inc.
12. Sola/Hevi-Duty Electric.
13. Square D/Groupe Schneider NA.
14. MGM.
15. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 MATERIALS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.
3. Coil Conductors: Continuous windings with terminations brazed or welded.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are internally braced to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Work."

C. Cores: One leg per phase.

D. Winding Taps, Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

E. Winding Taps, Transformers 15 KVA and Larger: ANSI/NEMA ST 20.

F. Basic Impulse Level: 10 KV.

G. Indoor Transformer Enclosure: Ventilated, NEMA 250, Type 2.

H. Outdoor Transformer Enclosure: Totally enclosed, non-ventilated, with lifting eyes or brackets, NEMA 250, Type 3R.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

I. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for "Indoor Corrosion Protection."

1. Finish Color: ANSI 61 gray.

J. Outdoor Transformer Enclosure Finish: Comply with NEMA 250 for " Outdoor Corrosion Protection."

1. Finish Color: ANSI 61 gray.

K. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

L. Taps for Transformers Smaller than 15 kVA: Two 5 percent tap above normal full capacity on primary windings.

M. Taps for Transformers 15 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

N. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.

2. Indicate value of K-factor on transformer nameplate.

O. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

2. Include special terminal for grounding the shield.
3. Shield Effectiveness:

    a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
    b. Common-Mode Noise Attenuation: Minus 120 dBA minimum at 0.5 to 1.5 kHz; minus 65 dBA minimum at 1.5 to 100 kHz.
    c. Normal-Mode Noise Attenuation: Minus 52 dBA minimum at 1.5 to 10 kHz.

P. Wall Brackets: Manufacturer's standard brackets.

2.5 CONTROL AND SIGNAL TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty, complying with NEMA ST 1, and listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide at least 50 percent spare capacity above connected peak load.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by CEC (NFPA 70) and manufacturer's written instructions.

C. Examine walls and floors for suitable mounting conditions where transformers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Work."

B. Install floor-mounting transformers level on concrete bases. Construct concrete bases of dimensions not less than 4 inches larger in both directions than supported unit and 4 inches high.

1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Work."
2. Isolate core and coil from enclosure using vibration-absorbing mounts.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

D. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

END OF SECTION 26 2200

SECTION 26 2413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes service and distribution switchboards rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Fuses."
2. Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
3. Division 26 Section "Electrical Power Monitoring and Control."

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. RFI: Radio-frequency interference.

C. RMS: Root mean square.

D. TVSS: Transient voltage surge suppressor.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, TVSS device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of switchboards and overcurrent protective devices.
d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
e. Metering provisions for BMS monitoring.
f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA PB 2.

D. Comply with CEC (NFPA 70).

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards, including clearances between switchboards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections of lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.6 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify University Representative not less than fourteen days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
2. Indicate method of providing temporary utilities.
3. Proceed with utility interruptions only after receiving University Representative written authorizations.

C. Environmental Limitations: Rate equipment for continuous operation under the following, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

D. Service Conditions: NEMA PB2, usual service conditions, as follows:

1. Altitude not exceeding 6600 feet.
2. Ambient temperatures within limits specified.

1.7 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corp.; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Div.
3. Siemens Energy & Automation, Inc.
4. Square D Co.
5. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 MANUFACTURED UNITS

A. Front-Connected, Front-Accessible Switchboard: Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.

1. Main Device on Switchboard MSB: Draw out mounted.
2. Branch Devices: Fixed, group- mounted.

B. Nominal System Voltage: 480Y/277 V.

C. Main-Bus Continuous: 4000 or as indicated on the drawings.

2.3 FABRICATION AND FEATURES

A. Enclosure: Steel: NEMA 250 type 1, NEMA 250 type 3

B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard light gray enamel finish over a rust-inhibiting primer on treated metal surface. Coat internal surfaces with corrosion resistant paint, or plate with cadmium or zinc.

C. Barriers: Between adjacent switchboard sections.

E. Utility Metering Compartment: Fabricated compartment and section complying with University's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.

F. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

G. Buses and Connections: Three phase, four wire, unless otherwise indicated. Include the following features:

1. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full ampere rating of circuit-breaker position.
2. Ground Bus: 1/4-by-2-inch minimum size, drawn-temper copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
3. Contact Surfaces of Buses: Silver plated.
4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Neutral Buses: 100 percent of the ampacity of the phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus is braced.

2.4 TVSS DEVICES

A. IEEE C62.41, integrally mounted, plug-in style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules Minimum single-impulse current rating shall be as follows:

1. Line to Neutral: 100,000 A.
2. Line to Ground: 100,000 A.
3. Neutral to Ground: 50,000 A.

B. Protection modes shall be as follows:

1. Line to neutral.
2. Line to ground.
3. Neutral to ground.

C. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.

D. Category C combination wave clamping voltage shall not exceed 600 V, line to neutral and line to ground on 120/208 V systems and 1000 V, line to neutral and line to ground on 277/480 V systems.

E. UL 1449 clamping levels shall not exceed 400 V, line to neutral and line to ground on 120/208 V systems and 800 V, line to neutral and line to ground on 277/480 V systems.

F. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping H. Accessories shall include the following:I1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.

G. Audible alarm activated on failure of any surge diversion module.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

B. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

C. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

D. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

E. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.

F. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

G. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

H. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting Copper lugs.
2. Two-step, stored-energy closing.
3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments with I^2t response.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Remote trip indication and control.
5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system.
6. Control Voltage: 120- VAC.

I. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.6 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.

2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

2.7 CONTROL POWER

A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

PART 3 - EXECUTION

3.2 EXAMINATION

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Support switchboards on concrete bases, 4-inch nominal thickness.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Work."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

E. Operating Instructions: Provide operating instructions at close out in Operations and Maintenance manual.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate.

3.5 CONNECTIONS

A. Install equipment grounding connections for switchboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.6 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.

B. Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.7 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 2413

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Lighting and appliance branch-circuit panelboards.
2. Distribution panelboards.

B. Related Sections include the following:

1. Division 26 Section "Vibration and Seismic Controls for Electrical Work."
2. Division 26 Section "Electrical Power Monitoring and Control."

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

F. TVSS: Transient voltage surge suppressor.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.

c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Closeout Procedures," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to the University, and marked for intended use.

C. Comply with NEMA PB 1.

D. Comply with CEC (NFPA 70).

1.5 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.6 EXTRA MATERIALS

A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Div.
c. Siemens Energy & Automation, Inc.
d. Square D Co.
e. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

B. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

D. Directory Card: Typed panel circuit schedule/index with transparent protective cover, mounted inside metal frame, inside panelboard door.

E. Bus: Hard-drawn copper, 98 percent conductivity.

F. Main and Neutral Lugs: Compression type suitable for use with conductor material.

G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box. When isolated grounds are required, provide ground bus insulated from box.

H. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

I. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

J. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

A. Main Overcurrent Protective Devices: Circuit breaker.

B. Branch overcurrent protective devices shall be one of the following:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers with Copper terminals.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers with Copper terminals; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
3. Fused switches.

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 225A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiterstyle fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with 5 -mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Compression style Copper, suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
6. Under-voltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking groundfault protection function.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Work."

C. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.

D. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

F. Install filler plates in unused spaces.

G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, with wire markers.

B. Panelboard Nameplates: Label each panelboard with laminated-plastic nameplate.

3.3 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Remove dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 2416

SECTION 26 2419 - MOTOR CONTROL CENTER

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, testing, and installation of motor control center to control the operation of the submersible pump and the UV unit.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions.

B. Submit manufacturer's descriptive and technical literature.

C. Submit manufacturer's descriptive data including ratings, single-line diagrams, three-line diagrams, control schematic wiring diagrams, dimensional data, weights, conduit entry restrictions, and overload relay ratings.

D. Submit control schematic diagrams in a “ladder diagram” format that satisfy the following minimum requirements:

1. Show unique rung numbers on left side of each rung. Provide unique wire numbers for all wires between terminals.

2. Show terminal numbers for all devices, relays, timers, contacts, etc.

3. Where the internal wiring diagrams of subassemblies are furnished on separate sheets, show as a rectangle in the schematic diagram with external points identified and cross-referenced to the separate sheets of the control circuit. Show coils and contacts internal to the subassemblies in the rectangle connected to their terminal points.

4. Use a cross-referencing system in conjunction with each relay coil so that associated contacts may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, describe the purpose of the contact on the same sheet. Show spare contacts.

5. Show symbols of external field devices on the schematic (ladder) diagram with utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position. If the equipment is shown in a specific position, identify the position.

6. Show contacts of multiple contact devices, e.g., selector switches, on the line of the schematic diagram where they are connected in a circuit. Indicate a mechanical connection between the multiple contacts by a dotted line or arrow. This does not apply to

control relays, starters, or contactors. Use additional charts or diagrams to indicate the position of multiple contact devices.

7. Show the purpose or function of switches adjacent to the symbols. Show the purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram on the right side of the respective rung.

8. The motor control center (MCC) manufacturer shall review the control schematic diagrams provided in the drawings, shall identify any adjustments that might be required to achieve the intended control features described in the drawings, and shall implement such changes, prior to shipping the equipment. If further adjustments are required, make such adjustments in the field, with the consent of the Owner's Representative.

E. Submit manufacturer's test report of the factory tests. Describe each circuit, logic function, device, or item tested. Describe results of tests and retests. Describe corrective action taken on defective circuits, logic functions, and devices.

PART 2 - MATERIALS

2.01 MCCs

A. MCCs shall be dead front, dead rear, floor standing, and front accessible NEMA 1 gasketed construction in a NEMA 3R nonwalk-in enclosure with locking provisions. Provide 10-inch minimum front access space between the exterior door and the front of the MCC. The NEMA 3R enclosure shall be provided with a duplex convenience outlet, fluorescent lighting operated from a lighting switch and thermostatically controlled space heaters and ventilation fans. Wiring shall be NEMA Class II, Type B (with wiring schematics showing field devices and connections). Tag control wiring within 2 inches of termination at each device and terminal board. Schematics shall also show terminal numbers and interior and field wire numbers. Delete last sentence of paragraph above if there is no instrument contractor.

B. Provide channel iron sills and removable lifting angles.

C. Provide a separate vertical wiring compartment for each MCC section. Provide cable supports and a hinged door separate from the unit starters.

D. Provide vertical bus insulated barriers.

E. Connect field control wires via terminal blocks. Provide hinged pull-apart terminal blocks for control wiring where foreign voltage may be present, in compliance with NEC 430.74.

F. Provide individual compartments separated by steel barriers and with separate hinged doors for each starter, circuit breaker, or other unit. Locate equipment to enable termination of field wiring from front without equipment removal.

G. Mechanically interlock starter and circuit breaker doors so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access while starter or circuit breaker is energized. Make provisions for padlocking external disconnect handles in the off position.

H. MCC shall have short-circuit current rating equal to or greater than kAIC rating.

I. Bus bars shall be copper. Provide full horizontal bus rating for entire length of the MCC. Do not taper the bus. Bus bars shall be tin plated.

J. Do not mount components or terminals on the sides of cubicles. Only mounting on back panels or front panels is acceptable.

K. Compartments allocated for controllers and other devices and number of sections shall not be less than those shown in the drawings. If sizes are required to be larger and/or number of sections is required to be more, they shall be provided at no extra cost to the Owner. If MCC elevation is not shown in the drawings, provide 6-inch minimum vertical space in addition to manufacturer's published space requirements for each starter compartment.

L. Mount devices without obstruction, to be readily accessible.

M. Main breaker, where used, shall be molded-case electronic type with the following adjustable trip features: long-time pickup, short-time pickup, short delay time, and instantaneous pickup.

N. Feeder circuit breakers shall be molded-case thermal-magnetic or electronic type. Provide quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual off and on positions. Provide trip ratings and number of poles as indicated in the drawings.

O. MCCs shall comply with applicable NEMA, UL, and ANSI standards for industrial control. Provide UL label on each MCC section.

P. Exterior finish shall be ANSI 49 gray.

Q. MCCs shall be General Electric 8000 line, Cutler-Hammer Freedom or Advantage 2100, Allen-Bradley Centerline, Siemens Tiastar, or equal.

2.02 PUMP CONTROL PANELS

A. Panels shall have NEMA 3R enclosure. Provide wing brackets for pole or cross bar mounting.

B. Provide the wide model enclosure for mounting additional equipment. Make provisions for padlocking external disconnect handle in the off position.

C. Panel shall include a full-voltage nonreversing contactor, a 3-pole manually reset thermal overload relay with reset button on the door, a fusible disconnect switch, a "hand-off-auto"

selector switch, and "start" button on the front or side of the panel, and additional controls as shown on the schematic diagrams.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Secure MCCs rigidly to walls and floors or mounting pads with anchor bolts or Phillips Drill Company concrete anchors. Anchor bolts or concrete anchors shall be carbon steel per ASTM A307, Grade B.

B. Install manual starters on C-channel supports, where such starters are shown away from walls, even if such channels are not explicitly shown at those locations.

3.02 FIELD TESTS

A. Perform the following minimum work under the technical direction of the manufacturer's service representative, if not included in their published start-up services:

1. Perform insulation tests on each phase and verify low-resistance ground connection on ground bus. Exclude such tests harmful to electronic components.

2. Torque bolted connections made in the field and verify factory-bolted connections.

3. Verify that factory-set adjustable set points of solid-state starter are in accordance with the motor manufacturer's recommendations.

B. Test the operation of each interlock to verify that the interlock performs its function.

C. Test system for correct execution of control logic. Adjust wiring connections in panel to correct errors.

D. Set adjustable trip circuit breakers two settings above the setting that causes the breaker to trip during motor starting. Do not adjust the setting above 1,300% of the motor nameplate current rating.

E. Operate each breaker and verify that all phases of each load are disconnected.

END OF SECTION 26 2419

SECTION 262719 – MULTI-OUTLET ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes multi-outlet assemblies.

B. Related Sections include the following:
   1. Division 26 Section “Wiring Devices" for receptacles.
   2. Division 27 Section “Communications Horizontal Cabling” for workstation outlets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include material descriptions, dimensions of profiles, cross sectional area, knockout sizes and locations, finishes, and standard fittings and accessories for multi-outlet assemblies.
   2. Describe materials and process for pre-marking assembly covers.

1.4 COORDINATION

A. Coordinate lengths of multi-outlet assemblies with dimensions of casework, benches, and equipment walls so that assemblies run their entire length, stopping within 1 inch of ends of casework, benches and equipment walls and within 12 inches of sinks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Wiremold/Legrand or comparable product by one of the following:
   1. Hubbell.
   2. Mono Systems.
   3. PG LifeLink.

2.2 MULTIOUTLET ASSEMBLIES

A. Type 2.
1. Description: Two compartment extruded aluminum channel with twin fitted covers and pre-wired receptacles suitable for use as multioutlet assembly.
2. Size: 5.25 inches by 1.75 inches.
3. Outlets: As shown on drawings.
4. Outlet Spacing: As shown on drawings.
5. Circuit Assignment: As shown on drawings.
6. Wiring: Provide separate neutral for each 120V circuit.
7. Receptacle Color: White for normal power devices and Red for standby devices.
8. Finish: Anodized aluminum. or as preferred by the Architect.
9. Covers.
   a. Receptacle Compartment: Pre-cut into 12 inch lengths.
   b. Low Voltage Compartment: Pre-cut into 12 inch lengths; punched to accept for telecommunications outlets and for refrigeration alarm monitoring.
10. Fittings: Furnish manufacturers standard couplings, elbows, connectors, and closures.
11. Identification.
    a. Provide per Division 26 "Identification for Electrical Systems."
    b. Indicate panel name and circuit number; for 208V outlets also indicate voltage, phase and amperage.
    c. Use black letters for normal power outlets and red letters for stand-by power outlets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install multi-outlet assemblies according to Manufacturer's instructions.

B. Use flat-head screws and Manufacturer's standard clips and straps to fasten assembly channel to surfaces.

C. Mount plumb and level.

D. Close ends of assemblies and unused conduit openings.

E. Ground and bond assemblies according to Division 26 Section "Grounding and Bonding."

3.3 IDENTIFICATION

A. Identify receptacles in assemblies according to Division 26 Section "Identification for Electrical Systems."

3.4 CLEANING

A. Clean exposed portions of multi-outlet assemblies with non-abrasive cleaner. Replace scratched covers.

END OF SECTION 26 2719

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles, ground-fault circuit interrupters, integral surge suppression units, and isolated-ground receptacles.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.
4. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. TVSS: Transient voltage surge suppressor.

E. UTP: Unshielded twisted pair.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with CEC (NFPA 70).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Toggle switches and receptacles shall be of the same manufacturer. Only one manufacturer shall be used in a building. Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:

a. Bryant Electric, Inc./Hubbell Subsidiary.
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Mfg. Company Inc.
d. Pass & Seymour/Legrand; Wiring Devices Div.
e. Or equal.

3. Multioutlet Assemblies:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Wiremold Company (The).
c. Or equal.

4. Poke-Through, Floor Service Outlets and Telephone/Power Poles:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Pass & Seymour/Legrand; Wiring Devices Div.
c. Square D/Groupe Schneider NA.
d. Thomas & Betts Corporation.
e. Wiremold Company (The).
f. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498, “Decora or style line” type in white color.

B. Locking Receptacles: Heavy-Duty grade.

C. Straight-Blade Receptacles: Specification grade/Institutional grade.

D. Controlled Duplex Receptacles.

1. Duplex Convenience Receptacles, 125 V, 20 A.
2. Device marked as controlled receptacle.
3. Products: Subject to compliance with requirements, provide one of the following:

    a. Pass & Seymour – 5362CD
    b. Hubbell – BR20C2
    c. Leviton – 5362-2P
    d. Or equal.

E. Combination USB Duplex Receptacles.

1. Duplex Convenience Receptacles, 125 V, 20 A, tamper resistant.
2. Device shall incorporate (2) USB ports and (2) AC outlets.
3. Products: Subject to compliance with requirements, provide one of the following:

    a. Pass & Seymour – TR5362USB
    b. Hubbell – USB20X2
    c. Leviton – T5832
    d. Or equal.

F. GFCI Receptacles: Straight blade, feed-through type, specification grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

G. Isolated-Ground Receptacles: Straight blade, specification grade, single duplex receptacle, orange color, with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.

1. Devices: Listed and labeled as isolated-ground receptacles.
2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

H. TVSS Receptacles: Straight blade, NEMA WD 6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.
2. Active TVSS Indication: Visual and audible with light visible in face of device to indicate device is "active" or "no longer in service."
3. Receptacle Type: Hospital grade, with isolated-ground terminal.
4. Identification: Distinctive marking on face of device to denote TVSS-type unit.

2.3 PENDANT CORD/CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, NEMA WD 6, Configurations as shown, Heavy-Duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 SWITCHES

A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20. . "Decora or style line" type in white color.

B. Snap Switches: Heavy -Duty grade, quiet type.

C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.

1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.

2.6 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish. Minimum of two screws per outlet box gang section.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch-thick, satin-finished stainless steel. When approved by the University cover plates may be nonmetallic, shatter resistant nylon in lieu of stainless steel.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Wet Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.7 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Solid brass with satin finish.

D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed.

2.8 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ45 jacks, Flush type with four simplex
2. Size: Selected to fit nominal 4-inch receptacles and space for four RJ-45 jacks or as indicated on the drawings. Core holes in floor and match to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 5 voice and data communication cables.

2.9 MULTIOUTLET ASSEMBLIES

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Base, cover and end plates shall be constructed of extruded aluminum #6063-T5, 0.060-inch minimum wall thickness. Finish shall be clear anodized #AA-C22A31, Class 2.

C. Wire: No. 12 AWG stranded.

2.11 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: White or as selected by University's Representative, unless otherwise indicated or required by CEC (NFPA 70).
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.

4. Isolated-Ground Receptacles for computers: As specified above, with orange triangle on face.
5. Coordinate final cover plate style and color with University's Representative. The following is a general guide:

    1) White or almond in office areas
    2) Stainless steel in laboratories, vivariums, and other high use areas.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions.

C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

E. Remove wall plates and protect devices and assemblies during painting.

F. Coordinate locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

G. Switches shall be installed in a minimum 4-inch by 4-inch outlet boxes.

3.2 IDENTIFICATION

A. Comply with Division 26 Section " Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
2. Cover plates for receptacles shall be engraved or permanent stenciled on the front side with the device circuit number and panelboard source name. Use of an engraving on the front of the device plate is not required for housing projects.
3. Cover plates for receptacles in locations of public view such as lobbies and atriums shall have the circuit numbers and source feed point stenciled on the back of the plate.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for electrical systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 26 2726

SECTION 26 2813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches and controllers.
2. Spare-fuse cabinets.

1.2 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.
4. Fuse size for elevator feeders and elevator disconnect switches.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with CEC (NFPA 70).

1.4 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussman, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.
5. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Service Entrance: Class L, time delay.

B. Feeders: Class L, time delay.

C. Motor Branch Circuits: Class RK1, time delay.

D. Other Branch Circuits: Class RK1, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

END OF SECTION 26 2813

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Bolted-pressure contact switches.
4. Enclosures.

B. Related Sections:

1. Refer to section 26 2413 for circuit breaker requirements.

1.2 DEFINITIONS

A. HD: Heavy duty.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.
4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with CEC (NFPA 70).

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. Testing requirements above are applicable to circuit breakers 200A and above and is not applicable to enclosed switches.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.
5. Or equal.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 FUSED POWER CIRCUIT DEVICES

A. Bolted-Pressure Contact Switch: UL 977; operating mechanism shall use a rotary-mechanical bolting action to produce and maintain high-clamping pressure on the switch blade after it engages the stationary contacts.

1. Manufacturers:
   a. Eaton Corporation; Cutler-Hammer Products.
   b. Pringle Electrical Mfg. Co.
   c. Siemens Energy & Automation, Inc.
   d. Square D/Group Schneider.
   e. Or equal.

2.4 MOLDED-CASE CIRCUIT BRAKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D I-Line Style bolt-on molded case circuit breakers or comparable product by one of the following. The listing of a manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents indicated on the drawings.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits in each pole. Adjustable magnetic trip setting for circuit-breaker frame sizes 150 A and larger, adjustable from the front.

D. Construct with over center, trip-free toggle type operating mechanisms with quick make, quick break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position. Provide breakers lugs AL/CU rated. Lugs shall be adequate to accept wire size indicated on the drawings.

E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

G. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA or more trip and hold below 4mA of ground fault current). One way circuit length shall not exceed 250 feet. If length exceeds 250 feet, notify engineer in writing prior to installing circuit.

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip). Provide as noted on plans and/or panel schedules and for all circuits supplying power to heat trace.

J. Where required to achieve system coordination with upstream and downstream overcurrent devices, solid-state circuit breakers shall be provided. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-sate sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13^{th} harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be toroidal construction, encased in a plastic housing, filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as described below;

1. Long time current pick up.
2. Adjustable long time delay.
3. Short time current pick up.
4. Adjustable short time delay.
5. Short time I square times t switch.
6. Instantaneous current pick up.
7. Ground fault current pick up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground fault current at the main bonding jumper or ground strap shall not be permitted. Provide ground fault only where indicated on the drawings.
8. Overload and short circuit and ground fault trip indicators shall be provided.

K. Interrupting ratings shall be as indicated on drawings. Circuit breakers shall be fully rated for available fault current. Series rating is not acceptable.

L. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Provide the following where noted on the drawings or schedules:

   a. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered for solid state type trip units and remote-mounted and powered for magnetic type trip units with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

   b. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.5 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Work."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Common Work Results for Electrical" and Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Common Work Results for Electrical" and Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

A. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 2816

SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ac general-purpose controllers rated 600 V and less that are supplied as enclosed units.

B. Related Sections include the following:

1. Division 26 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
2. Division 26 Section "Transient Voltage Suppression" for low-voltage power, control, and communication surge suppressors.
3. Division 26 Section "Fuses" for fuses in fusible switches.

1.2 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details.
b. Nameplate legends.
c. Short-circuit current rating of integrated unit.
d. UL listing for series rating of overcurrent protective devices in combination controllers.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with CEC (NFPA 70).

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, including clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subjected to weather, cover enclosed controllers to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify the University at least fourteen days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
2. Indicate method of providing temporary utilities.
3. Do not proceed with utility interruptions without University's Representative written permission.

1.6 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Manual and Magnetic Enclosed Controllers:

a. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
b. Eaton Corp.; Cutler-Hammer Products.
c. General Electrical Distribution & Control.
d. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
e. Square D Co.
f. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 MANUAL ENCLOSED CONTROLLERS

A. Description: NEMA ICS 2, general purpose, Class A, with toggle action and overload element, full voltage controller for fractional horse power motors, single pole and auxiliary contacts.

2.3 MAGNETIC ENCLOSED CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.

B. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices,

C. Combination Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.
2. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, non-fusible switch.
3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

E. Multispeed Enclosed Controller: Match controller to motor type, application, and number of speeds; include the following accessories:

1. Compelling relay to ensure motor will start only at low speed.
2. Accelerating relay to ensure properly timed acceleration through speeds lower than that selected.
3. Decelerating relay to ensure automatically timed deceleration through each speed.

F. Star-Delta Controller: NEMA ICS 2, open transition.

G. Part-Winding Controller: NEMA ICS 2, closed transition with separate overload relays for starting and running sequences.

H. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.

1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
3. LED indicators showing motor and control status, including the following conditions:

    a. Control power available.
    b. Controller on.
    c. Overload trip.
    d. Loss of phase.
    e. Shorted silicon-controlled rectifier.

I. Auxiliary contacts: NEMA ICS2, two normally open and two normally closed contacts in addition to seal-in contact.

J. Indicating lights: NEMA ICS2 run green in front cover.

K. Selector switch: NEMA ICS2, hand/off/auto in front cover.

2.5 ENCLOSURES

A. Description: Flush- or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 4.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.6 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

2.7 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. See Division 26 Section "Common Work Results for Electrical" for general installation requirements.

B. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Common Work Results for Electrical."

C. Install freestanding equipment on concrete bases complying with Division 03 Section "Cast-inPlace Concrete."

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Work."

E. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 IDENTIFICATION

A. Identify enclosed controller components and control wiring according to Division 26 Section "Common Work Results for Electrical" **"**Identification for Electrical Systems."

3.5 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment.

C. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.7 FIELD QUALITY CONTROL

A. Provide voltage test.

B. Check rotation

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 CLEANING

A. Clean enclosed controllers internally, on completion of installation, according to manufacturer's written instructions.

3.10 STARTUP SERVICE

A. Verify that enclosed controllers are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION 26 2913

SECTION 26 3213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for standby power supply with the following features:

1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Load bank.
5. Outdoor enclosure.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.
2. Division 26 Section "Seismic Restraint For Electrical Systems" for requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Factory published specification sheet indicating standard and optional accessories, ratings, etc.
2. Manufacturer’s catalog cut sheets of all auxiliary components such as isolators, battery charger, silencer, exhaust flex, main circuit breaker, etc.
3. Dimensional elevation and layout drawings of the generator set, enclosure and switchgear and related accessories.
4. Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.
5. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
6. Generator resistances, reactances and time constants.
7. Generator current decrement curve.

8. Time current characteristic curves for generator protective device.
9. Generator motor starting capability.
10. Generator thermal damage curve.
11. Control panel schematics.
12. Oil sampling analysis, laboratory location, and information.
13. Manufacturer's and dealer's written warranty.
14. Emissions data.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
3. Interconnect Wiring Diagrams: including generator, switchgear, fuel tank, battery charger, jacket water heater, space heater and remote alarm indications.
4. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.

C. Submit a coordination study in conjunction with panelboards showing that all article 700 – Emergency and 701 – Legally Required Standby systems, both on the normal and emergency are selectively coordinated as required by code. Refer to additional requirements of Division 26 Section “Overcurrent Protective Device Coordination Study”.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification:

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
4. Report of sound generation.
5. Report of exhaust emissions showing compliance with applicable regulations.
6. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

C. Field quality-control test reports.

D. Warranty: Special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with all applicable codes.

G. Comply with NFPA 99.

H. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

I. Generator set shall be UL2200 Listed with UL 2200 labeling.

J. Engine Exhaust Emissions: Comply with current federal Environmental Protection Agency, applicable state and local government requirements.

K. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 40 deg C.

2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet

1.8 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturer’s standard warranty period (minimum two years) from date of start-up.
2. Labor and travel time for necessary repairs at the job site shall be included.
3. Running hours shall not be a limiting factor for the system warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar; Engine Div.
2. Kohler Co.; Generator Division.
3. Onan/Cummins Power Generation; Industrial Business Group.
4. Generac

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and tested.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Generator to be standby rated, 750 kW, 937.5 kVA at .8 P.F., 480Y/277 volts, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance (Voltage Dip): Not more than 15% variation for 100 percent step-load increase or decrease at rated power factor. Voltage shall recover and remain within the steady-state operating band (within 0.5% of rated voltage) within five seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform at Full Linear Load: Harmonic content measured line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Output Waveform at No Load: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
9. Start Time: Comply with NFPA 110, Type 10, system requirements. Upon loss of power the generator shall start and assume emergency load within 10 seconds.
10. An oversized alternator shall be provided to handle the harmonics from VFD Loads.

2.3 ENGINE

A. Heavy duty industrial, naturally aspirated or turbo-charged, with in-line or vee-type, four cycle compression ignition diesel.

B. Fuel: Fuel oil, Grade DF-2.

C. Rated Engine Speed: 1800 rpm.

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Replaceable elements rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances. Drain extension shall be provided through side of skid base.
4. Low pressure cut-out.
5. Engine oil blow-by emission recirculation kit or route blow-by tube into exhaust discharge duct.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
3. Shut-off Valve: Solenoid valve to shut off fuel to the engine when the Emergency Stop button is activated.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

1. Jacket heater shall be, 9000 watts, 208 volts, single phase with adjustable thermostat.

G. Governor: Manufactured by Woodward or equal. Electronic, adjustable isochronous, with speed sensing and overspeed cutout.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of ethylene-glycol-based antifreeze and water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 60 seconds.
4. Battery: Lead acid type with adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Stranded copper, sized as recommended by engine manufacturer. Include required interconnecting conductors and connection accessories.
6. Battery Rack: Factory fabricated of metal with acid-resistant finish. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: 120V, Current-limiting, automatic-equalizing and float-charging type. Unit shall be UL listed and comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Battery Heater: 120V, with thermostat as required by NFPA 110.
    d. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    e. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    f. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    g. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Factory installed and piped, UL 142 listed fuel oil tank. Features include the following:

1. Tank level indicator.
2. Capacity: Fuel for 24 hours' continuous operation at 100 percent rated power output.
3. Vandal-resistant fill cap.
4. Containment Provisions: Comply with requirements of authorities having jurisdiction.
5. Fuel strainer for mounting in the fuel intake line.
6. Drain hand valve in lieu of threaded plug in bottom of tank.
7. Secondary fuel filter/water separator.
8. Manual fuel priming pump.
9. Fuel tank shall be double wall construction with leak alarm.
10. Fuel tank shall meet all local and State codes and standards.
11. Emergency fuel shut-off valve.
12. Low fuel alarm switch set at 8 hours for remote indication.
13. Provide mechanical type fuel gauge.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

C. The control panel shall be mounted on the generator set. The control panel shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

D. The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions in a common control and monitoring panel mounted on the generator set. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of alarm and shutdown conditions on an alphanumeric digital display panel.

1. Digital Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

    a. AC voltmeter.
    b. AC ammeter.
    c. AC frequency meter.
    d. DC voltmeter (alternator battery charging).
    e. Engine-coolant temperature gage.
    f. Engine lubricating-oil pressure gage.
    g. Running-time meter.

h. Ammeter-voltmeter, phase-selector switch(es).
i. Generator-voltage adjusting control.
j. Fuel tank high-level shutdown of fuel supply alarm.
k. Generator overload (alarm)
l. Oil pressure sender failure (alarm)
m. Engine temperature sender failure (alarm)
n. Fail to crank (shutdown)
o. Fail to start/overcrank (shutdown)
p. Weak battery (alarm)
q. Low fuel-daytank (alarm)
r. High AC voltage (shutdown)
s. Low AC voltage (shutdown)
t. Under frequency (shutdown)
u. Over current (warning)
v. Over current (shutdown)
w. Short circuit (shutdown)

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Common Remote Audible Alarm Annunciator: Include necessary contacts and terminals in control and monitoring panel. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated. Alarm conditions shall also be monitored by the Building Automation System (BAS). Provide necessary interface for connection to BAS. Comply with NFPA 99 and NFPA 110 requirements for Level 1 systems and the following:

1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.
6. Battery high-voltage alarm.
7. Loss of normal power to charger alarm.
8. Low coolant level.
9. High engine temperature.
10. Low oil pressure.
11. Over-Speed
12. Generator supplying load.
13. Low fuel – base-mounted fuel tank.
14. High fuel level – base-mounted fuel tank.

G. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

1. Shall activate electric fuel solenoid shut-off valve on engine.
2. Locate in Main Electrical Room – see drawings for exact location.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker(s): Molded-case, Solid State - electronic-trip type; 100 percent rated; complying with UL 489. Refer to drawings for quantities and amperage ratings.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.
5. Short circuit rating shall be a minimum of 35kA.
6. Where required to achieve system coordination with upstream and downstream overcurrent devices, solid-state, electronic trip, circuit breakers shall be provided and where noted on drawings and schedules and where required by code to achieve selective coordination.

    a. All overcurrent devices on article 700 – Emergency and 701 – Legally Required Standby systems, both on the normal and emergency side shall be selectively coordinated as required by code.

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H with Class F temperature rise.

D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity. Generator stator and exciter stator windings shall have additional treatment of epoxy for resistance to an environment of moisture and salt air.

E. Unit to sustain 300% rated output for 10 seconds to allow downstream selective circuit breaker tripping in the event of a fault. Either series boost or PMG acceptable. Generator supplier to install all series boost components. So called "extended stacks" will not be acceptable.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state digital type, separate from exciter, providing performance as specified.

1. Three phase sensing with automatic, +/- 1/2% voltage regulation from no load to full load.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point. Voltage shall be 120 volts.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.8 RADIATOR-MOUNTED LOAD BANK

A. Description: Provide radiator-mounted load bank , resistiveunit capable of providing a balanced 3-phase, delta-connected load to generator set at [**50**] percent rated-system capacity. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and steel supports. Elements shall be double insulated and designed for repetitive on-off cycling.

2.9 OUTDOOR WEATHERPROOF GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof aluminum housing. The engine/generator set, including battery charger and batteries and exhaust silencer shall be completely enclosed in a weatherproof sound attenuated outdoor enclosure provided by the generator manufacturer.

1. Sound Attenuation Requirements: Average 25 dBA sound attenuation at 21 feet in a free field.
2. The enclosure shall be constructed of minimum .08 inch aluminum.
3. The engine crank case breather/ventilation tubes shall be extended into the vertical discharge plenum section of the weatherproof enclosure.
4. Muffler Location: Within enclosure.

B. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

C. Size shall be as required to house generator and accessories.

D. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Equipped with bird screen arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents. Storm-proof and drainable louvers prevent entry of rain.
2. Hinged Doors: With padlocking provisions.
3. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.

E. Provide enclosure mounted to sub-base fuel tank. Slip-over enclosures are not acceptable. Provide structural metal platform for access to control panel if top of main breaker(s) and control panel’s control buttons or displays exceeds 72” above finished grade.

2.10 FINISHES

A. Metal parts shall be primed and finish painted at the factory for corrosion resistance in an outdoor environment.

B. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

C. Color of generator enclosure shall be “special” color as selected by Owner.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories. Prototype testing shall include:

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
2. Fuel consumption at 1/4, 1/2, 3/4, and full load
3. Exhaust emissions
4. Mechanical and exhaust noise
5. Governor speed regulation at 1/4, 1/2, 3/4, and full load; and during transients
6. Motor starting kVA
7. Generator temperature rise in accordance with NEMA MG1-22.40
8. Voltage regulation at 1/4, 1/2, 3/4, and full load; and during transients
9. Harmonic analysis, voltage waveform deviation and telephone influence factor
10. Generator short circuit capability
11. Cooling system performance
12. Torsional analysis
13. Linear vibration analysis
14. Generator revolving field assembly for 2 hours at 2700 rpm (150% overspeed) and 70°C, and each production unit tested at 2250 rpm (125% overspeed) at room temperature.
15. The manufacturer shall supply equipment that is a current factory production model, not a onetime fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch on 4-inch- high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."

1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.
2. Exhaust pipe shall turn upward and be provided with a weather proof cap.

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

F. Provide initial full fill of diesel fuel.

3.3 CONNECTIONS

A. Connect engine exhaust pipe to engine with flexible stainless steel flanged connector.

B. Connect fuel piping to engines with a gate valve and union and flexible connector.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a local factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Coordinate all start-up and testing activities with the Engineer and Owner.
2. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following.

    a. Verify that the equipment is installed properly.
    b. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciater, etc.
    c. Test all alarms and safety shutdown devices for proper operation and annunciation.
    d. Check all fluid levels.
    e. Start engine and check for exhaust, oil, and fuel leaks, vibrations, etc.
    f. Verify proper voltage and phase rotation at the switchgear before connecting to the load.
    g. Connect the generator the building load and verify that the generator will start and run all designated loads.

3. Load Bank Test:

    a. Provide a 3-phase portable load bank at project site, in addition to prototype and factory test. Load bank shall have sufficient rating to test generator to full nameplate rating at a 1.0 (resistive) power factor. Load bank shall be performed after generator installation is complete including all room doors and louvers installed and all transfer switches connected and operational.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
7. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
9. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Remove and replace malfunctioning units and retest as specified.

F. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

G. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests. Submit written test results to Engineer.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators after load bank test and after engine/generator set is electrically connected to automatic transfer switches.

1. Include a minimum of three simulated power failures in the presence of transfer switch manufacturer's startup representative.
2. Test remotely connected engine/generator status indication signals.
3. Test transfer switches.
4. Contractor to coordinate meeting to ensure presence of all parties concerned.

3.7 SYSTEM SERVICE CONTRACT

A. In order to meet potential insurance company regulations and provide longest reliable service life, the supplier of the standby power system shall provide and make available to the Owner a service contract which, at the Owner's option, may be accepted or refused. The contract shall be for the complete services rendered over a period of one year and shall include, but not be limited to, the following:

B. Engine manufacturer's recommended procedures for weekly (biweekly) inspection and maintenance to be done by user.

C. Quarterly inspection by the supplier personnel to review the weekly (biweekly) maintenance records being kept by user and train any new Owner operating personnel. Inspection will include scheduled oil sampling for lube oil contaminants. A 100% load test run on the generator set shall also be included.

D. Annual inspection shall include all of items in above paragraph except that the generator set shall be run under load - system load or load provided by supplier.

SAFETIES CHECKLIST

FUNCTION	CV	S	CA	RV	RA	VERIFIED
(A) OVERCRANK	X	X	X	X	X	
(B) LOW WATER TEMP. <70°F (21°C)	X		X	X	X	
(C) HIGH ENGINE TEMPERATURE PREALARM	X		X		X	
(D) HIGH ENGINE TEMPERATURE	X	X	X	X	X	

(E) LOW LUBE OIL PRESSURE PREALARM	X		X		X	
(F) LOW LUBE OIL PRESSURE	X	X	X	X	X	
(G) OVERSPEED	X	X	X	X	X	
(H) LOW FUEL MAIN TANK (48 HR)				X	X	
(I) LOW COOLANT LEVEL	X		X		X	
(J) EPS SUPPLYING LOAD	X			X		
(K) CONTROL SWITCH NOT IN AUTO. POSITION	X		X		X	
(L) BATTERY CHARGER MALFUNCTIONING	X		X	X		
(M) HIGH BATTERY VOLTAGE	X		X			
(N) LOW VOLTAGE IN BATTERY	X		X			
(O) LAMP TEST	X			X		
(P) CONTACTS FOR LOCAL AND REMOTE COMMON ALARM	X				X	
(Q) AUDIBLE ALARM SILENCING SWITCH			X		X	
(R) LOW STARTING AIR PRESSURE (1)	X		X	O		
(S) LOW STARTING HYDRAULIC PRESSURE (1)	X		X	O		
(T) AIR SHUTDOWN DAMPER WHEN USED	X	X	X	O	X	
(U) REMOTE EMERGENCY STOP		X				
(V) LOW FUEL DAY TANK				X	X	
(W) HIGH FUEL LEVEL DAY TANK				X	X	
(X) GROUND FAULT WHEN PROVIDED				X	X	
(Y) CRANK CYCLE TEST 15 SEC. ON 15 OFF	-	-	-	-	-	
(Z) CONTINUOUS CRANK MAX. 45 SEC. (2)	-	-	-	-	-	
(AA) CYCLE CRANKING LIM (SEC) 75 MAX.	-	-	-	-	-	
(BB) FLOAT TYPE BATT. CHGR W/DC AMMETER & VOLTMETER	-	-	-	-	-	
(CC) BATTERY RECHARGE TIME - 24 HOURS	-	-	-	-	-	
(DD) BLOCK HEATER DISCONNECT ON START	-	-	-	-	-	
(EE) WATER TEMPERATURE MIN. 90°F (OUTSIDE UNITS)	-	-	-	-	-	
(FF) BATTERY HEATERS MAINTAIN 50° - 90°F (3)	-	-	-	-	-	

(GG) GENERATOR ROOM TEMP. MIN 70°F						

Key:

CV - Control panel mounted visual indication.
CA - Control panel – mounted audible
RV - Remote visual
RA - Remote audible
S - Shutdown of EPS
X - Required
O - Can be a common audible and visual signal

Notes:

(1) Only applies when applicable as a starting method.
(2) All diesel engines shall be permitted to use continuous cranking methods.
(3) Not required if enclosure temperature maintained at not less than 32°F.

GENERATOR COLD START LOAD TEST

DATE:	TIME:	REMARKS:
TIME DELAY ON START		
CRANK TIME TO START		
TIME TO OPER. SPEED		
VOLTAGE OVERSHOOT		
FREQUENCY OVERSHOOT		
TIME TO STEADY STATE WITH ALL ATS=S TRANSFERRED		
AMBIENT TEMP.		

START TIME	0 MIN.	5 MIN.	10 MIN.	15 MIN.	30 MIN.	45 MIN.	60 MIN.	75 MIN.	90 MIN.	120 MIN.
VOLTS PHASE A										
VOLTS PHASE B										
VOLTS PHASE C										
FREQUENCY A										
FREQUENCY B										

FREQUENCY C										
AMPERES A										
AMPERES B										
AMPERES C										
OIL PRESSURE										
WATER TEMP										
BATTERY CHRG RATE										
STOP TIME:										

GENERATOR FULL LOAD TEST

DATE:	TIME:	REMARKS:
CRANK TIME TO START		
TIME TO OPER. SPEED		
VOLTAGE OVERSHOOT		
FREQUENCY OVERSHOOT		
TIME TO STEADY STATE WITH ALL ATS=S TRANSFERRED		
AMBIENT TEMP.		

START TIME	0 MIN.	5 MIN.	10 MIN.	15 MIN.	30 MIN.	45 MIN.	60 MIN.	75 MIN.	90 MIN.	120 MIN.
VOLTS PHASE A										
VOLTS PHASE B										
VOLTS PHASE C										
FREQUENCY A										
FREQUENCY B										
FREQUENCY C										
AMPERES A										
AMPERES B										

AMPERES C										
OIL PRESSURE										
WATER TEMP										
BATTERY CHRG RATE										
STOP TIME:										

INSTANTANEOUS VOLT DIP ON ONE STEP	INSTANTANEOUS VOLT DIP ON ONE STEP	FREQUENCY DROOP (ONE STEP LOAD)	FREQUENCY DROOP (ONE STEP LOAD)
FACTORY =	FIELD =	FACTORY =	FIELD =

TRANSFER SWITCH DATA

ATS BRANCH	BRANCH NAME	TYPE AUTO/ MAN	SIZE AMPS	NO. POLES	AIC & VOLTS	TIME TO EMERG. IN SEC=S	RE-TRANSFER TO NORM TIME IN MIN.

END OF SECTION 26 3213

SECTION 26 3600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic open-transition transfer switches.
2. Non-bypass/isolation switches.
3. Remote annunciation system.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Wiring Diagrams: Single-line diagram. Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

C. Qualification Data: For manufacturer and testing agency. Submit with electrical test reports.

D. Field quality-control test reports. Submit with electrical test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Sections "Closeout Procedures" and "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain automatic transfer switches, open trasition, and remote annunciators through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1- General Standards for Industrial Control and Systems

E. Comply with NEMA IC52 – Standards for Industrial Control Devices

F. Comply with NEMA IC56 – Enclosures for Industrial Controls and Systems; Type 1 -indoors, Type 4 - outdoors.

G. Comply with CEC (NFPA 70).

H. Comply with NFPA 99.

I. Comply with NFPA 110.

J. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. Caterpillar; Engine Div.
b. Emerson; ASCO Power Technologies, LP.
c. Generac Power Systems, Inc.
d. GE Zenith Controls.
e. Kohler Co.; Generator Division.
f. Onan Corp./Cummins Power Generation; Industrial Business Group.
g. Russelectric, Inc.
h. Spectrum Detroit Diesel.
i. Or equal.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

C. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels have communication capability matched with remote device.

D. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

G. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

H. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

J. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric motor-operated mechanism, mechanically and electrically interlocked in both directions.

K. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. Open Transition In-Phase Transfer ATS

1. Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage

G. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

2.4 AUTOMATIC TRANSFER-SWITCH FEATURES

A. Under-voltage Sensing for Each Phase of Normal Source: Senses low phase-to-ground voltage on each phase. Pickup voltage is adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

B. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

C. Voltage/Frequency Lockout Relay: Prevents premature transfer to generator. Pickup voltage is adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency is adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

D. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained under voltage of emergency source, provided normal supply has been restored. Upon permission by normal

source monitor by alternative source monitor: 0 to 30 seconds adjustable. E. Test Switch: Simulates normal-source failure.

F. Switch-Position Pilot Lights: Indicate source to which load is connected.

G. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
2. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

H. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 480-V ac.

I. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

J. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine generator controls after retransfer of load to normal source.

K. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

1. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
2. Push-button programming control with digital display of settings.
3. Integral battery operation of time switch when normal control power is not available.

J. Elevator control interface auxiliary contacts. Transfer switches serving elevators shall be provided with auxiliary contacts designed to provide emergency system status to the elevator controllers. These contacts are in addition to the contacts required elsewhere in this specification. Required auxiliary contacts are as follows:

1. Emergency Power signal contact. This shall be a form “C” contact that will change state and maintain its state as long as the transfer switch has transferred to the emergency power source.
2. Pre-transfer warning signal contact. This contact shall be activated prior to the operation of the transfer switch, in either direction. These contacts shall change state prior to the transfer of power for a period of time as determined by the elevator installer, typically in the range of 10 to 20 seconds. These contacts shall reset to their normal state after the

transfer has taken place. The pre-transfer warning signal shall not delay transfer for a time greater than allowed by the applicable codes

2.6 FINISHES

A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.7 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.2 INSTALLATION

A. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical System."

1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base minimum of 4 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated. Cast anchor-bolt inserts into bases. Comply with Division 03 Section "Cast in Place Concrete."

B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

C. Identify components according to Division 26 Section "Common Work Results For Electrical and Electrical Identification."

3.3 WIRING TO REMOTE COMPONENTS

A. Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to University if necessary to accommodate required wiring.

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Measure insulation resistance phase-to-phase and phase-to-ground with insulation resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.

    e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cooldown and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Sections "Closeout Procedures" and "Demonstration and Training."

1. Coordinate this training with that for generator equipment.

END OF SECTION 26 3600

SECTION 26 4313 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes transient voltage surge suppressors for low-voltage power, control, and communication equipment.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for devices with integral transient voltage surge suppressors.
2. Division 26 Section "Panelboards" for factory-installed transient voltage surge suppressors.
3. Division 26 Section "Switchboards" for factory-installed transient voltage surge suppressors.

1.2 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories. Submit with switchboards submittal.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

D. Comply with NEMA LS 1.

E. Comply with UL 1283 and UL 1449.

F. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify University's Representative 14 days in advance of proposed electrical service interruptions.
2. Do not proceed with interruption of electrical service without the University's Representative's written permission.

B. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet above sea level.

1.6 COORDINATION

A. Coordinate TVSS devices with Division 26 Section "Electrical Power Monitoring and Control."

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Manufacturers of a Broad Line of Suppressors:

a. Advanced Protection Technologies, Inc.
b. Current Technology, Inc.
c. Cutler-Hammer, Inc.
d. Innovative Technology, Inc.
e. Intermatic, Inc.
f. Northern Technologies.
g. Siemens Energy & Automation.
h. Square D Co.
i. General Electric Co.
j. Or equal.

2. Manufacturers of Category A and Telephone/Data Line Suppressors:

a. MCG Electronics, Inc.
b. NTE Electronics, Inc.
c. Telebyte Technology, Inc.

B. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protective Device Description: Non-modular type with the following features and accessories:

1. LED indicator lights for power and protection status Copper lugs.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 a, 250-V ac, for remote monitoring of protection status.

B. Surge Protective Device Description: Modular design with field-replaceable modules and the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring Copper lugs.
3. Integral disconnect switch.

4. Arrangement with copper busbars and for bolted connections to phase buses, neutral bus, and ground bus.
5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
6. Red and green LED indicator lights for power and protection status.
7. Audible alarm, with silencing switch, to indicate when protection has failed.
8. One set of dry contacts rated at 5 a and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
9. Surge-event operations counter.

C. Peak Single-Impulse Surge Current Rating: 240kA per phase.

D. Connection Means: Permanently wired.

E. Protection modes and UL 1449 clamping voltage for grounded wye circuits with voltages of 480Y/277 and 208Y/120; 3-phase, 4-wire circuits, shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120.
2. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.
3. Neutral to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

2.4 CONTROL AND DATA TERMINALS

A. Protectors for copper control, data, and telephone conductors entering the building from the outside shall be as recommended by the manufacturer for the type of line being protected.

2.5 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install devices for panelboard with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide multipole, 15-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated, or direct bus mounted, internal to electrical equipment.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 FIELD QUALITY CONTROL

1. Verify that electrical wiring installation complies with manufacturer's installation requirements.

END OF SECTION 26 4313

SECTION 26 5100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures with lamps and ballasts.
2. Lighting fixtures mounted on exterior building surfaces.
3. Emergency lighting units.
4. Exit signs.
5. Bi-level Lighting fixtures installed in stairwells.
6. Accessories, including fluorescent fixture dimmers, occupancy sensors, lighting fixture retrofitting, fail-safe feature and lamp conditioning.

B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for manual or programmable control systems employing low-voltage control wiring or data communication circuits.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers.
3. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
4. Division 26 Section "Dimming Controls" for architectural dimming systems.

1.2 DEFINITIONS

A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.

B. CRI: Color rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:

1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.

F. RCR: Room cavity ratio.

1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes.

B. Coordination Drawings: Submit shop drawings per BIM Execution Plan under section “BIM Specifications”.

C. Operation and Maintenance Data: Provide record submittal with final fixture selections.

1.4 QUALITY ASSURANCE

A. Comply with CEC (NFPA 70).

B. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

C. CBC 2013 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with the light fixture schedule.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Light-emitting diodes, life.

2.3 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Common Work Results for Electrical" for channel- and angle-iron supports and nonmetallic channel and angle supports.

2.5 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Refer to fixture schedule on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceilings and walls.

1. Install minimum ceiling support system rods or wires for each fixture.

B. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

C. Adjust directional fixtures to provide required light intensities.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Verify normal operation of each fixture after installation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to emergency power source (generator) and retransfer to normal.

D. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

E. Louver shall be protected from construction contaminants by polyethylene cover until substantial completion.

END OF SECTION 26 5100

SECTION 26 5100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures with lamps and ballasts.
2. Lighting fixtures mounted on exterior building surfaces.
3. Emergency lighting units.
4. Exit signs.
5. Bi-level Lighting fixtures installed in stairwells.
6. Accessories, including fluorescent fixture dimmers, occupancy sensors, lighting fixture retrofitting, fail-safe feature and lamp conditioning.

B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for manual or programmable control systems employing low-voltage control wiring or data communication circuits.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers.
3. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
4. Division 26 Section "Dimming Controls" for architectural dimming systems.

1.2 DEFINITIONS

A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.

B. CRI: Color rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:

1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.

F. RCR: Room cavity ratio.

1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.
2. Emergency lighting unit battery and charger.
3. Energy-efficiency data.
4. Air and Thermal Performance Data: For air-handling fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
5. Sound Performance Data: For air-handling fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section "Diffusers, Registers and Grilles."
6. Life, output, and energy-efficiency data for Lamps.
7. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products. B. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Submit shop drawings per BIM Execution Plan under section “BIM Specifications”.

C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to University's Representative, and marked for intended use.

B. Comply with CEC (NFPA 70).

C. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire suppression system, and partition assemblies.

1.6 WARRANTY

A. Special Warranty for Emergency Lighting Unit Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 2 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Provide positive cam action steel latches and safety lock T-hinges.

G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch minimum, unless otherwise indicated.
b. UV stabilized.

2. Parabolic-type reflector lens shall have minimum three-inch anodized aluminum cubes except it can be smaller for areas with glare protection requirement.
3. Glass: Annealed crystal glass, unless otherwise indicated.

J. Electromagnetic-Interference Filters: A component of fixture assembly. Suppress conducted electromagnetic-interference as required by MIL-STD-461E. Provide radio-interference filter Sprague Cat JN-14-16351. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

K. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 23 Section "Diffusers, Registers, and Grilles."

1. Air Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
2. Heat Removal Units: Air path leads through lamp cavity.
3. Combination Heat Removal and Air Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air supply units.
4. Dampers: Operable from outside fixture for control of return-air volume.
5. Static Fixtures: Air supply slots are blanked off, and fixture appearance matches active units.

2.3 LIGHTING FIXTURES

A. Fixtures shall generate comply with:

1. Minimum BF: 0.88 unless noted otherwise.
2. Minimum LER: 1.466 unless noted otherwise.

2.4 LED LUMINARES

A. LED luminaires shall provide a continuous and controllable light source. Lamp output and dimensions shall be in accordance with contract drawings and specifications. LED luminaire lumen output will be in accordance with the specifications and shall not depreciate more than 20% after 10,000 hours of use. Rated lumen output for LED luminaires to operate in ambient temperature of minus 4°F -20°C to 122°F +50°C. Luminaires to have minimum life of 50,000 hours.

B. All LEDs used in the LED luminaires will be of high brightness and proven quality. All LEDs shall be driven digitally with pulse width modulation control to prolong life and maintain consistency of lumen output.

C. All connections to luminaires will be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

2.5 LED DRIVES (POWER SUPPLIES)

A. All LED drivers to be compatible with LEDs. All LED luminaires and drivers (power supplies) shall be furnished by single manufacture to insure compatibility.

B. Drivers shall be integral to the luminaire, unless noted otherwise.

C. Electric Characteristics (at 77°F ambient temperature)

1. Input Voltage Range - 108V to 132V
2. Efficiency Minimum – 80%
3. Output Current Regulation Range (+/-) 5%A
4. Total Harmonic Distortion (THD) – 20% maximum
5. Power Factor – 0.9 minimum
6. Crest Factor (LED Current) – 1.5 maximum
7. FCC Class B for Conducted EMI
8. FCC Class A for Radiated EMI
9. Drivers life – 50,000 hours minimum

2.6 FLUORESCENT LAMP BALLASTS

A. Description: Include the following features, unless otherwise indicated:

1. Designed for type and quantity of lamps indicated at full light output except for emergency lamps powered by in-fixture battery-packs.

B. Electronic ballasts for linear lamps shall include the following features, unless otherwise indicated:

1. Comply with NEMA C82.11.
2. Ballasts shall be UL Listed, Class 'P' automatic resetting electronic type and operate lamps at a frequency above 20 KHz from an input frequency of 60 Hz and shall deliver lamp manufacturer's normal rated lamp life. Ballast size, mounting configuration, and audible noise levels produced shall be lower than CBM certified ballast for same application. Ballasts shall be "A" sound rated.
3. Ballasts shall be designed to operate two, three, and/or four, four foot, 32 watt, Super T-8 fluorescent lamps. Ballasts shall have parallel lamp connection capable of operating remaining lamp(s) at full output if one or more lamps within the same luminaire fail or are removed.
4. Utilize reduced harmonic ballasts with an input power factor (ratio of actual power to apparent power) above 0.98, and harmonic distortion less than 15 percent Total Harmonic Distortion (THD). When harmonic distortions of less than 10 percent THD are required, provide high-efficiency ballasts with a power factor above 0.99.
5. Ballast Type: Rapid start, input power factor (ratio of actual power to apparent power) .98 and above, and harmonic distortion less than 15 percent Total Harmonic Distortion (THD). When harmonic distortions of less than 10 percent THD are required, provide high-efficiency ballasts with a power factor above 0.99.
6. Programmed Start: Ballasts with two-step lamp starting to extend life of frequently started lamps.
7. Sound Rating: A.
8. Total harmonic distortion rating of less than 10 percent according to NEMA C82.11.

9. Ballast shall provide soft/stable start of rapid start lamps and maintain cathode heat during operation. The ballast shall provide an isolated output to the lamps. Ballast case shall be positively grounded to the light fixture metal housing.
10. Voltage: Ballasts shall consistently start and operate lamps from a supply line voltage of 277 volts within plus or minus 10 percent except for buildings with 208-volt service. The light output wattage shall not vary by more than 2 percent over the 10 percent variation in line voltage.
11. Transient Voltage Protection: IEEE C62.41, Category A.
12. Operating Frequency: 20 kHz or higher.
13. Lamp Current Crest Factor: Less than 1.7.
14. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
15. Fusing: Ballasts shall be individually fused inside each lighting fixture with insulated fuse holder. The sign on the fixture interior shall read "BALLASTS ARE FUSED".

C. Electromagnetic ballasts for linear lamps shall have the following features, unless otherwise indicated:

1. Comply with NEMA C82.1.
2. Type: Energy-saving, high power factor, Class P, automatic-reset thermal protection.
3. Ballast Manufacturer Certification: Indicated by label.

D. Ballasts for compact lamps in recessed fixtures shall have the following features, unless otherwise indicated:

1. Type: Electronic.
2. Power Factor: 98 percent, minimum.
3. Flicker: Less than 5 percent.
4. Lamp Current Crest Factor: Less than 1.7.
5. Electronic Ballast Operating Frequency: 20 kHz or higher.
6. Lamp end-of-life detection and shutdown circuit.
7. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
8. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

E. Ballasts for compact lamps in non-recessed fixtures shall include the following features, unless otherwise indicated:

1. Power Factor: 90 percent, minimum.
2. Ballast Coil Temperature: 65 deg C, maximum.
3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

F. Ballasts for dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:

1. Dimming Range: 100 to 10 percent of rated lamp lumens 100 to 1 percent where projection equipment is utilized..
2. Ballast Input Watts: Can be reduced to 20 percent of normal.

3. Compatibility: Certified by manufacturer for use with specific dimming system indicated.
4. Dimming ballasts shall be designed to operate one, two or three lamps.
5. Dimming ballast lead length shall not exceed seven (7) feet for Super T-8 lamps.
6. Dimming manufacturer shall approve dimming ballasts for use with the specified dimming equipment.
7. Dimming ballast manufacturers shall have been producing electronic dimming ballasts for a minimum of five years, and have ISO 9001 quality certification. G. Ballasts for Low-Temperature Environments:

1. Temperatures 0 deg F and Higher: Electronic type rated for 0 deg F minus 17 deg C starting temperature.

H. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

2.7 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F.
4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 15 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Lamp Current Crest Factor: 1.5 or less.
6. Power Factor: 0.90 or higher.
7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
8. Protection: Class P thermal cutout.
9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
10. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.

    a. High-Level Operation: 100 percent of rated lamp lumens.
    b. Low-Level Operation: 35 percent of rated lamp lumens.

c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and colorrendering capability.

11. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.

a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.
b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.

C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.

D. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniterstarter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.

a. Restrike Range: 105- to 130-V ac.
b. Maximum Voltage: 250-V peak or 150-V ac RMS.

2. Minimum Starting Temperature: Minus 40 deg F.
3. Open-circuit operation shall not reduce average lamp life.

2.8 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with the University.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay

disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
7. Integral Self-Test: Factory-installed electronic device automatically initiates coderequired test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
8. Master/Remote Sign Configurations:

    a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
    b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.9 EMERGENCY LIGHTING UNITS

A. General: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Wire Guard: Where indicated, heavy-chrome-plated wire guard protects lamp heads or fixtures.
5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
6. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit

triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

9. Integral Self-Test: Factory-installed electronic device automatically initiates code required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.10 FLUORESCENT EMERGENCY LIGHTING FIXTURES

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night Light Connection: Operate one fluorescent lamp continuously.
3. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
4. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
5. Charger: Fully automatic, solid-state, constant-current type.

B. Central Type: Factory installed, full light output, fluorescent emergency ballast to operate lamps indicated from a remote emergency power source.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night Light Connection: Operate one fluorescent lamp in a remote fixture continuously.
3. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Class 1 enclosure or as required by University's Representative.

2.11 BI-LEVEL STAIRWELL LIGHTING FIXTURES

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Occu-Smar lighting fixture by LaMar Lighting Co., or equal. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night Light Connection: Operate one fluorescent lamp continuously.
3. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
4. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
5. Charger: Fully automatic, solid-state, constant-current type.
6. Fail-safe switch switches light level to high (100%) if sensor is physically damaged.
7. High-frequency, extremely sensitive ultra-sonic, internally mounted.

2.12 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with Federal toxic characteristic leaching procedure test, and yield less than 0.2 mg of mercury per liter, when tested according to NEMA LL 1.

B. Premium T-8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches 2800 initial lumens (minimum), CRI of 85 (minimum), color temperature of 4100 K, and average rated life of 24,000 hours, unless otherwise indicated.

C. Compact Fluorescent Lamps: 4-Pin low mercury, CRI 82 (minimum), color temperature 2700, average rated life of 10,000 hours at 3 hours operation per start and if required suitable for use with dimming ballasts, unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.13 HIGH-INTENSITY-DISCHARGE LAMPS

A. High-Pressure-Sodium Lamps: NEMA C78.42, wattage and burning position as scheduled, CRI 21 (minimum), color temperature 1900, and average rated life of 24,000 hours.

1. Dual-Arc Tube Lamps: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80 and color temperature 4000 K.

D. Metal-Halide Lamps: ANSI C78.1372, wattage and burning position as scheduled, CRI 65 (minimum), and color temperature 4000.

2.14 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. AC/Battery Powered Exit Signs: Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.

b. Charger: Fully automatic, solid-state type with sealed transfer relay.
c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.15 FIXTURE SUPPORT COMPONENTS

Comply with Division 26 Section "Common Work Results for Electrical" for channel- and angle-iron supports and nonmetallic channel and angle supports.

A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage.

D. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

E. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

G. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.16 FINISHES

A. Fixtures: Manufacturers' standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.
3. Interior: finished with high-gloss, based white enamel.
4. Material: metal body 22 gauge, metal endplate 20 gauge.

2.17 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Refer to fixture schedule on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

1. Install minimum ceiling support system rods or wires for each fixture.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
5. Lighting fixtures installed in accessible ceilings with removable ceiling tiles shall have a junction box located within 6 feet of light fixture concealed above the ceiling. It shall have flexible steel conduit (maximum of 6 feet long) from junction box to fixture.

B. Each lighting fixture installed on or flush in non-accessible ceiling cavities shall have a junction box accessible through the fixture body, or by removing the light fixture body from ceiling, without damage to ceiling.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Suspend from cable.

D. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust directional fixtures to provide required light intensities.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Verify normal operation of each fixture after installation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

D. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

E. Louver shall be protected from construction contaminants by polyethylene cover until substantial completion.

END OF SECTION 26 5100

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric switches.
3. Poles and accessories.
4. Luminaire lowering devices.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 SUBMITTALS

A. Product Data: For each luminaire, pole and support component, arranged in the order of lighting unit designation. Include data on features, accessories, finishes.

B. Shop Drawings: Submit per BIM Execution Plan under section “BIM Specification”.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to the University, and marked for intended use.

B. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with CEC (NFPA 70).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping.

PART 2 - PRODUCTS

2.1 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use.

D. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled

2.3 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.4 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

2.5 REQUIREMENTS FOR INDIVIDUAL EXTERIOR LIGHTING DEVICES

A. Refer to Exterior Lighting Fixtures Schedule on the drawings.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Luminaire Attachment: Fasten luminaire to indicated structural supports.

B. Adjust luminaires that require field adjustment or aiming.

3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

END OF SECTION 26 5600

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric switches.
3. Poles and accessories.
4. Luminaire lowering devices.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.2 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.

B. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.

1. Wind speed for calculating wind load for poles 50 feet or less in height is 70 mph.

1.3 SUBMITTALS

A. Product Data: For each luminaire, pole and support component, arranged in the order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Ballasts, including energy-efficiency data.
7. Lamps, including life, output, and energy-efficiency data.
8. Materials, dimensions, and finishes of poles.
9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
10. Anchor bolts for poles.
11. Manufactured pole foundations.

B. Shop Drawings: Submit per BIM Execution Plan under section “BIM Specification”.

1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC (NFPA 70), Article 100, by a testing agency acceptable to the University, and marked for intended use.

C. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with CEC (NFPA 70).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.6 Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship; corrode; or fade, stain, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”,

Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens. G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal Baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected by University's Representative from manufacturer's full range.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

    a. Color: Dark bronze.

2.3 EXTERIOR LUMINAIRES

A. Luminaires:

1. Luminaire Street Lighting: General Electric model #M-250A-POWR/DOOR luminares, or equal. High-pressure sodium 250-Watt luminaries with self-contained 480-volt ballast shall be utilized along streets, roadways and pedestrian crossings.

    a. Street lighting shall be concrete standards with eight-foot aluminum davit arm. Ameron Contemporary series 1C1 octagonal pole anchor base, with anti-graffiti and sealer.

b. Minimum set back is 30 inches back from face of curb.
c. Check with the University when adding fixtures of this type to the campus existing power circuits.
d. Each fixture shall be fused with time delay fuse in a weatherproof holder in the head.

3. Parking Area Lighting: Gardco model Hardtop 22 inch CA series bronzed anodized finish or equal by Kim Lighting with high pressure sodium lamp (no known equal).

a. Poles should be 5-inch diameter, straight round aluminum with dark bronze with anodized finish as manufactured by Thomas Lighting.

4. Ground lighting: Landscape lighting of trees and plants shall be limited. Ground lighting must account for the very corrosive nature of the University soil. Do not recess metal fixture in the soil. Provide pedestal or non-metallic materials.

5. Pathway Lighting: Gardco model #CA 17-100HPS-480-BRA-HF or equal by Kim Lighting (no other known equal). Use 150 Watt lamps in well-lit areas when directed by the University.

a. Lighting standards shall be Gardco model #RA4-12-AF-D1-BRA, 4-inch diameter, aluminum bronze anodized, straight round pole with a round base cover.
b. Pathway lighting with bollards shall be minimized. If bollards are used in planting areas where exposure to pedestrian and bicycle traffic is minimal bollard shall be Ameron model #B20X1.5BP 113 LUC DB, 100 Watt 480V concrete aggregate type.
c. Pathway lighting for major spokes from the ring mall shall use campus theme light fixture. The University shall determine when a pathway is a major spoke.
d. University shall approve the use of handrail lighting. If used, it shall be C.W. Cole, cat #1586-5 with PL-13 lamps.

6. Exterior Lighting:

a. Exterior surface building mounted in public areas, Kim Lighting model WF 20, WF 31, or WF22. Lamps shall be high-pressure sodium or compact fluorescent.
b. Service area fixtures shall be Holophane Wallpack II with 150 Watt high pressure sodium lamp, model WL2K 15AHP MTBZ.

2.4 LUMINAIRE –MOUNTED PHOTOELECTRIC

RELAYS

A. UL 773 or UL 773A listed.

B. Contact Relays: Factory mounted, Single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Contacts shall have directional lens in front of photocell to prevent fixed light sources to cause turnoff.

1. Relay with locking-type receptacle shall comply with NEMA C136.10.

2. Adjustable window slide for adjusting on-off set points.
3. Exterior lighting circuits shall be multi-staggered to minimize a total outage.

2.5 FLUORESCENT LAMP BALLASTS

A. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures 0 deg F and higher.

B. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
6. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F and higher.

D. Fluorescent Lamps: Low-mercury type. Comply with the EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

2.6 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated:

1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F.
4. Open-circuit operation will not reduce average life.
5. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

B. Auxiliary, Instant-On, Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.

C. High-Pressure-Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Solid-state igniter/starter with an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant Restrike Device: Integral with ballast, or solid-state potted module, mounted inside high-pressure-sodium fixture and compatible with high-pressure-sodium lamps, ballasts, and mogul sockets up to 150 W.
    a. Restrike Range: 105- to 130-V ac.
    b. Maximum Voltage: 250-V peak or 150-V ac RMS.
2. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
3. Open-circuit operation will not reduce average life.

2.7 FLUORESCENT LAMPS

A. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature 3500, averaged rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

1. T4, Double-Twin Tube: Rated 18 W, 1200 initial lumens (minimum).
2. T4, Double-Twin Tube: Rated 26 W, 1800 initial lumens (minimum).

2.8 HIGH-INTENSITY-DISCHARGE LAMPS

A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

B. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.

C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.9 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping.

B. Factory-Painted Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Interior Surfaces: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected by University's Representative from manufacturer's standard catalog of colors.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

    a. Color: Dark bronze.

3. Anodic Coating: Architectural Class I, impregnated color coating 0.018 mm or thicker) complying with AAMA 611.

2.11 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.12 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: Match UCR standard campus lighting.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Steel Mast Arms: Continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole and bracket, then bolted together with galvanized-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.

F. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.

G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

H. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

I. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.

J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

K. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

L. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected by University's Representative from manufacturer's full range.

2.13 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: Match UCR standard campus lighting.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
2. Finish: Same as pole

F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

5. Color: As selected by University's Representative from manufacturer's full range

2.14 FIBERGLASS POLES

A. Poles: Comply with ANSI C136.20, with access handhole in pole wall.

1. Mounting: Embedded.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

A. Resin Color: Match UCR standard campus lighting, provide uniform coloration throughout entire wall thickness.

B. Surface Finish: Pigmented polyurethane, with a minimum dry film thickness of 1.5 mils.

2.15 DECORATIVE POLES

A. Pole Material:

1. Cast ductile iron.
2. Cast gray iron, according to ASTM A 48/A 48M, Class 30.
3. Cast aluminum.
4. Cast concrete.
5. Spun concrete.
6. Steel tube, covered with closed-cell polyurethane foam, with a polyethylene exterior.

B. Mounting Provisions:

1. Bolted to concrete foundation.
2. Embedded.

C. Fixture Brackets:

1. Cast ductile iron.
2. Cast gray iron.
3. Cast aluminum.

D. Pole Finish: Match UCR standard campus lighting.

2.19 POLE ACCESSORIES

.

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

2.20 REQUIREMENTS FOR INDIVIDUAL EXTERIOR LIGHTING DEVICES

A. Refer to Exterior Lighting Fixtures Schedule on the drawings.

a.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Luminaire Attachment: Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming.

3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet

C. Trees: 15 feetConcrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers, unless otherwise indicated.
4. Use a short piece of 1/2-inch-diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Dig holes large enough to permit use of tampers in the full depth of hole.
2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Make holes 6 inches in diameter larger than pole diameter.
2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
3. Use a short piece of 1/2-inch-diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
4. Cure concrete a minimum of 72 hours before performing work on pole.

G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.

H. Raise and set poles using web fabric slings (not chain or cable).

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inchesabove finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-inPlace Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.7 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.8 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 5600

SECTION 27 0500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Communications equipment coordination and installation.
2. Sleeves for pathways and cables.
3. Sleeve seals.
4. Grout.
5. Common communications installation requirements.

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. SCS: Structural Communications System

1.3 SUBMITTALS

A. Product Data: For sleeve seals.

1.4 COORDINATION

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting pathways, cables, wire ways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

A. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

B. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Or Equal: Where products are specified by manufacturers name and accompanied by the term “or equal”, comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before the use of an unnamed manufacturer or product.

2.2 SLEEVES FOR PATHWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches thickness shall be 0.052 inch
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches thickness shall be 0.138 inch.

2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:

a. Advance Products & Systems, Inc.
b. 3M
c. Hilti

d. STI
e. Or equal.

3. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
4. Pressure Plates: Carbon steel, Stainless steel. Include two for each sealing element.
5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATION INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, wire ways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies. Generally the electrical trade will supply the pathways and spaces, verify that this item is covered by electrical trades. Additional path if not covered by electrical, will be required to be supplied by SCS contractor.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve

seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 27 0500

SECTION 27 1100 - TELECOMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.1 THE WORK DESCRIPTION OF WORK

A. Shall consist of the provision, termination, and testing of complete and fully-functional Structured Cabling System (SCS) for telephone and data system network. This work shall include provision of but not limited to the following:

1. Telephone and data system equipment racks, cable runway in BDF/IDFs, patch panels and associated hardware.

B. Provide all incidental items that belong to the Work described and which are required for a complete system.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Section 01 91 13 - General Commissioning Requirements.

1.3 QUALIFICATIONS

A. Manufacture:

1. Provide products of manufacturers as named in individual articles.
2. Where no manufacturer is specified, provide products of manufacturers in compliance with requirements and referenced standards.

B. Installer:

1. Installer shall own and maintain tools and equipment approved by the manufacturer for installation equipment cabinets, racks, ladder racking, and cable management.
2. SCS Installer shall carry out the telephone and data network system installation work detailed in this specification.
3. A specialist installer company that has completed work of a similar nature shall carry out the installation work detailed in this specification.

1.4 SUMMARY

A. This Section includes the following items for mounting and routing of the SCS within the telecommunications spaces:

1. Equipment Cabinets
2. Equipment Racks

3. Cable Ladder Racking and fittings
4. Vertical Cable Management
5. Horizontal Cable Management
6. Grounding and Bonding
7. Identification products.

1.5 DEFINITIONS

A. Backbone:	A facility (e.g., pathway, cable, or conductors) between telecommunications rooms or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.
B. BDF:	Building Distribution Frame.
C. BICSI:	Building Industry Consulting Service International.
D. Cross-Connect:	A facility enabling the termination of cable elements and their interconnection or cross-connection.
E. EMI:	Electromagnetic interference.
F. Horizontal Cabling:	Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. Also the cabling between and including the building automation system outlet or the first mechanical terminations on the horizontal connection point and the horizontal cross-connect.
G. IDC:	Insulation displacement connector.
H. IDF:	Intermediate Distribution Frame.
I. LAN:	Local area network.
J. MDF:	Main Distribution Frame.
K. RCDD:	Registered Communications Distribution Designer.
L. SCS:	Structured Cabling System: SCS is defined in this document as all required horizontal category 6 cabling including associated hardware, patch panels, BDF/IDF patch cords, information outlets, faceplates, work area patch cords, installed and configured to provide telephone and/or computer data network connectivity.
M. TGB:	Telecommunications Grounding Busbar (IDF locations).
N. TMGB:	Telecommunications Main Grounding Busbar (BDF location).
O. UTP:	Un-shielded twisted pair cable.

1.6 SUBMITTALS

A. Provide Product Data: For each type of product indicated.

B. Shop Drawings:

1. Termination fields: Detail mounting assemblies, and show elevations and physical relationship between the installed components.

2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

C. Qualification Data: For Installer**,** qualified layout technician, installation supervisor, and field inspector.

1.7 AS BUILT DOCUMENTATION

A. As-built documentation shall consist of all the construction drawing enlarged room plans and wall elevation plans indicating placement of each piece of installed equipment

1.8 COORDINATION

A. Coordinate layout and installation of voice and data communication cabling prior to start of work.

1. Adjust arrangements and locations of distribution frames and racks and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.9 **MATERIALS STANDARDS**

A. Products, services, and materials provided by the Design-builder shall meet the requirements of the following (latest edition):

1. National Electrical Manufacturer's Association (NEMA).
2. American National Standards Institute (ANSI).
3. Institute of Electrical and Electronic Engineers (IEEE).
4. Underwriter's Laboratories, Inc., (UL) or equivalent.
5. National Electric Code (NEC).
6. National, State, and Local OSHA building and fire codes.
7. TIA/EIA/ Standard TIA/EIA-568-B.1 - Commercial Building Telecommunications Cabling Standard; Part 1: General Requirements.
8. TIA/EIA Standard TIA/EIA-568-B.2 - Commercial Building Telecommunications Cabling Standard; Part 2: Balanced Twisted-Pair Cabling Components.
9. TIA/EIA Standard TIA/EIA-568-B.3 - Optical Fiber Cabling Components Standard.
10. TIA/EIA Standard TIA/EIA-569-A - Commercial Building Standard for Telecommunications Pathways and Spaces.
11. TIA/EIA Standard TIA/EIA-606A Administration Standard for Commercial Telecommunications Infrastructures.
12. TIA/EIA Standard TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.

B. Products, services, and materials provided by the Design-builder shall be new and of high quality and free of faults and defects.

1.10 WARRANTY

A. Provide a one year warranty for all installed equipment.

PART 2 PRODUCTS AND SYSTEM REQUIREMENTS

2.1 MANUFACTURERS

A. Manufacturers (Campus Standard):

1. Chatsworth Products Inc. (CPI), or equal, (see note), for in Telecom Room(s); seven-foot by 19-inch data equipment racks, cable runway and support products to include vertical cabling (between racks) management.

   Note; use one manufacturer for all racks, cable runway, vertical cable managers and associated hardware.
2. Panduit, or equal, for horizontal wire management products.

2.2 DATA SYSTEM EQUIPMENT RACKS, HARDWARE AND GROUNDING

1. Provide Data System Equipment Rack(s) minimum three (3) per BDF/ IDF. and associated hardware as required for a complete system.
2. Provide standard 3" deep channel 19" wide and 84" high Data System Equipment Rack(s). Equipment Rack(s) shall be Chatsworth Products Inc. 55053-703 UL Listed, or equal.
3. Provide all mounting components and accessories to securely fix racks to floor, overhead cable runway and supporting walls.
4. Each rack shall have a load-carrying capacity of 1000 lbs.
5. Provide Chatsworth Products 11729-703, or equal, vertical cable management on each side of the rack, or equal.
6. Provide strain relief and cable management at the rear of each 48 port patch panel to ensure tidy routing of all feeder and distribution cables.
7. Provide Chatsworth Products 31472-718 Alternate Space Cable Runway, or equal, over Data System Equipment Racks. Provide all associated hardware as required for a complete installation.
8. Provide Chatsworth Products 10250-718 Universal Cable Runway, or equal, over Data System Equipment Racks. Provide all associated hardware as required for a complete installation.
9. Provide two (2) CPI #13239-757 Horizontal Rack-Mount Power Strip with Ten (10) Outlets and NEMA 5-20P Straight Plug with Amp Meter, Surge Protection and Circuit Breaker, or equal, in each Data System Equipment Rack.
10. Provide one (1) CPI # 13622-012 Grounding Busbar (TMGB or TGB), BICSI & ANSI/EIA/TIA, or equal, in the BDF and in each IDF Telecom Rooms. Connect each TMGB and TGB to electrical panel serving BDF or IDF Telecom Room with #6AWG green insulated, stranded THHN conductor wire, or equal, using two-hole compression lugs on each end.
11. Provide #6AWG green insulated, stranded THHN conductor wire, or equal, from each Data Equipment Rack(s), Cable Runway(s) and Cable Sheath(s) to the Main Telecommunications Ground Bus (BDF) or Telecommunications Ground Bus (IDF). Terminate each end of #6 conductor wire with two-hole compression lug; connect lugs to TMGB or TGB.
12. Data Equipment Rack(s) shall be securely attached to the concrete floor using Chatsworth Products 40604-003 Rack and Frame Installation Kit, or equal. For additional strength solidly attach racks to overhead Cable Runway. When mounted in a row, maintain a

minimum of 60 inches from the wall behind and 36" in front of the row of racks. Where racks are shown side by side securely connect together to provide a stable system.

13. Provide all necessary Chatsworth Products, or equal, hardware to make a complete system as required but not limited to:

    a. 11421-712 Wall Angle Support Kit, Cable Runway
    b. 11302-701 Junction-Splice Kit
    c. 40164-001 Cable Runway Ground Strap Kit
    d. 11301-701 Butt-Splice Kit
    e. 11310-003 Threaded Ceiling Kit, Cable Runway
    f. 11312-718 Triangular Support Bracket, Aluminum

2.3 DATA SYSTEM HORIZONTAL PATCH MANAGEMENT

A. Provide horizontal patch management panel(s) for each Data System Equipment Rack(s). Provide one (1) Panduit WMPHF2E (front pathway only) 2U-high horizontal cable manager(s), or equal, above and below each 48 port patch panel and each 10 Outlet power strip.

2.4 TELEPHONE AND DATA SYSTEM LABELS

A. Provide labels for all equipment racks, and grounding and bonding equipment.

B. The lettering on each label shall be as large as is practicable. All labels shall be machine produced. Handwritten labels will not be acceptable.

C. A standard relative orientation shall be adopted for all labels unless otherwise specified.

D. Labels shall be robust, durable, shall resist abrasion, and shall be UV inhibiting, permanent and indelible. Labels shall be proof to 140° Fahrenheit.

E. Labels shall be readily visible and shall be fixed so that they remain in a visible position wherever practical.

F. Labels shall carry the full complement of characters to designate the unique identification for the item that they identify.

G. Termination Frame (110 Blocks and Patch Panels) Labels. Provide pre-printed labels on card for 110 blocks. Label each frame on the front, enabling terminations to be clearly identified. Cable terminations on frames shall be uniquely labeled in strict numerical order with the lowest numbered cable to the top left of the allocated portions of the frame.

2.5 TELEPHONE SYSTEM BACKBOARDS

A. Provide telephone system plywood backboards (4-foot by 8-foot by ¾-ich) on all walls at 6-inch AFF. Each plywood backboard shall be fire-retardant plywood, painted with two coats of white fire-retardant intumescent paint with one (1) fire rating stamp per sheet of plywood masked prior to painting and visible after installation. Exposed edges shall be chamfered, with no exposed screws, bolts, nuts, washers, or other protruding fastenings.

2.6 GROUNDING AND BONDING

A. Materials: Comply with NFPA 70, TIA/EIA-607, and UL 467.

2.7 IDENTIFICATION PRODUCTS

A. Manufacturers:

1. Brady Corporation, Inc.
2. Panduit Corp.
3. Hellerman-Tyton
4. Kroy LLC.

B. Comply with TIA/EIA-606-A Class 3 and University Standards for Telecom Identification.

C. Cable Labels: Self-Laminating Vinyl Cables Labels, machine printed with alphanumeric cable designations.

2.8 SOURCE QUALITY CONTROL

A. All equipment shall be of new stock and inspected for damage prior to installation.

PART 3 EXECUTION

3.1 INSTALLATION STANDARDS

A. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

B. Cabling Pathways shall be installed in a “neat and workmanlike manner” as specified by ANSI/NECA/BICSI 568-2001 and National Electrical Code (NEC) Sections 110-12 and 800-6.

C. The Design-builder shall adhere to and comply with the latest versions and/or revisions of each applicable standard. Among the various standards, guide-lines and practices applicable to this project are the latest editions of the following:

1. Building Industry Consulting Services International (BICSI) Installation Manual
2. BICSI Telecommunications Distribution Methods Manual
3. California Building Standards Commission
4. California Electrical Code (2004) Title 24, Part 3
5. Federal Communications Commission (FCC)
6. FCC Part 68.5 Establishment of Telephone Premises Wiring Attestation List
7. Insulated Cable Engineers Association (ICEA)
8. National Electrical Manufacturers Association (NEMA)
9. NEMA WC 66 (2001) Premise Wiring
10. National Fire Protection Association (NFPA)
11. NFPA 70 (2008) National Electrical Code

12. TIA/EIA-526-14A (August 1998) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14
13. TIA/EIA-568-B.1 (2004) Commercial Building Telecommunications Wiring Standard
14. TIA/EIA-568-B.2 (2003) Commercial Building Telecommunications Wiring Standard
15. TIA/EIA-568-B.3 (2002) Optical Fiber Cabling Components Standard (ANSI/TIA/EIA-568-B.3-2000)
16. TIA/EIA-569-A (1998) Commercial Building Standard for Telecommunications Pathways and Spaces (ANSI/TIA/EIA-569-A-98)
17. TIA/EIA-569-A-2 (2000) Commercial Building Standard for Telecommunications Pathways and Spaces, Addendum 2 (ANSI/TIA/EIA-569-A-2-2000). This addendum defines the furniture pathways and spaces contained in work areas.
18. TIA/EIA-606-A (2002) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
19. ANSI/J-STD-607-A (2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
20. TIA/EIA – 758 (April 1999) Customer-Owned Outside Plant Telecommunications Cabling Standard
21. UNDERWRITERS LABORATORIES INC. (UL)
22. UL 467 (1993; Bul. 1994 and 1996, R 1996) Grounding and Bonding Equipment
23. UL 514C (1988; R 1989, Bul. 1993 and 1994) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
24. UL 969 (1995) Marking and Labeling Systems
25. UL 1863(1995) Communication Circuit Accessories

D. Federal, state, local codes, rules, regulations, and ordinances governing the work shall be incorporated as part of these Technical Specifications.

E. In reviewing the various Contract Documents, the Design-builder shall be responsible for resolving conflicts between proposed design/concepts and the applicable standards, guidelines and practices.

3.2 EXAMINATION

A. Examine telecommunications spaces.

1. Review proposed telecommunications space layout drawings with owner.
2. Proceed with installation only after owner approval of proposed layout.

3.3 INSTALLATION PRACTICE

A. Comply with NECA 1.

B. Wiring within Wiring Closets and Enclosures:

1. Use cable strain relief brackets behind all patch panels to prevent straining connections to prevent bending cables to smaller radii than minimums recommended by manufacturer.

C. Provide and install fire stopping in accordance with all local and NFPA regulations to sustain ratings when passing through (floors, wall or ceilings) with; conduits, sleeves, raceway, cable tray, wire basket cable tray through fire-rated elements.

D. The Design-builder shall individually and properly ground all voice termination frames, data system equipment racks, copper riser sheaths and cable runway with #6AWG green stranded wire to the TMGB or TGB using two-hole compression lugs on each end.

3.4 GROUNDING

A. Comply with the appropriate Division 26 Section for "Grounding and Bonding" and with TIA/EIA 607.

B. Grounding Points:

1. Locate grounding busbars (MTGB) in BDF and (TGB) in each IDF Telecom Rooms.
2. Provide a ground connection from all voice termination frames, data system equipment racks, copper riser sheaths and cable runways to the grounding terminals in the MDF/BDF and IDFs.

3.5 LABELING AND NUMBERING CONVENTIONS

A. General.

1. All devices shall be labeled with a standard identification tag. Tags shall be typewritten or stamped with indelible waterproof ink and mechanically secured in a permanent fashion. Handwritten labels are NOT acceptable. Labels shall be mounted in a manner, which permits easy access and viewing. All equipment and fittings shall be identified using the following conventions.

3.6 IDENTIFICATION

A. Administration Drawings: Identify labeling convention and show labels for telecom rooms, backbone pathways, entrance pathways, terminal hardware and positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings.

3.7 FIELD QUALITY CONTROL

A. Perform the installation following established industry best practices.

3.8 TESTING AND DOCUMENTATION

A. General:

1. A University Representative, at the option of the University, shall be present during testing.
2. Such acceptance testing shall in no way reduce the Design-builders' obligations regarding restoration, clean up, or warranty.
3. Design-builder shall be responsible for performing, tracking, and recording the results of tests.

END OF SECTION 27 1100

SECTION 27 1300 - COMMUNICATIONS BACKBONE CABLING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The work shall consist of the provision, termination, and testing of complete and fully-functional Structured Backbone Cabling System for telephone and data system network. This work shall include provision of but not limited to the following:

1. Telephone and data system optical/copper patch cords.
2. Telephone and data system optical fiber/copper riser cables.

B. The work shall not include provision of the following:

1. Telephone handsets and active switching equipment.
2. Integrated Services Digital Network equipment.
3. Telephone services or active computer and networking equipment.
4. Computer and network software.
5. Copper and Fiber entrance cables, air blown fiber (ABF) bundles and tube cables.

C. Provide all incidental items that belong to the Work described and which are required for a complete system.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Wire Basket cable tray system, raceways, conduits and boxes, external duct bank tie and other components that make up the infrastructure pathways that will carry the telephone and data cabling shall be furnished and installed by the electrical Design-builder.

C. Section 01 91 13 - General Commissioning Requirements.

1.3 QUALIFICATIONS

A. Manufacture:

1. The SCS specified products for the backbone cabling (e.g. cable, patch panels, termination blocks, patch cords, etc.) shall be supplied by a single manufacturer.
2. Manufacturer shall have a minimum of ten (10) years of experience in the manufacture of the specified cabling products and shall be ISO 9001/14000 Certified.

B. Installer:

1. Installer shall be certified by the manufacture company in all aspects of design, installation and testing of the SCS horizontal cabling specified products.

2. The installer shall utilize the authorized backbone cabling manufacturer components and distribution channels in provisioning this Project.
3. Installer shall own and maintain tools and equipment approved by the cabling system manufacturer for installation and testing of the cabling.
4. SCS Installer shall have a proven track record in the field of telephone, data, and fiber cabling installation, with at least five previous installations of comparable size and complexity undertaken within the last five years.
5. Installer shall be qualified in the installation and termination of optical fiber cabling as described in this specification.
6. Installer shall be an authorized CommScope Systimax® Business Partner and shall provide the CommScope Systimax® Solutions 20-year extended product warranty and application assurance on this installation.

1.4 SUMMARY

A. This Section includes the following items for wiring systems used as signal pathways for voice and high-speed data transmission:

1. Mounting elements.
2. Un-shielded twisted-pair cabling.
3. Fiber-optic cabling (Single-mode and/or Multi-mode).
4. Identification products.

1.5 DEFINITIONS

A.	Backbone:	A facility (e.g., pathway, cable, or conductors) between telecommunications rooms or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.
B.	BDF:	Building Distribution Frame.
C.	BICSI:	Building Industry Consulting Service International.
D.	Cross-Connect:	A facility enabling the termination of cable elements and their interconnection or cross-connection.
E.	EMI:	Electromagnetic interference.
F.	Horizontal Cabling:	Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. Also the cabling between and including the building automation system outlet or the first mechanical terminations on the horizontal connection point and the horizontal cross-connect.
G.	IDC:	Insulation displacement connector.
H.	IDF:	Intermediate Distribution Frame.
I.	LAN:	Local area network.
J.	MDF:	Main Distribution Frame.
K.	RCDD:	Registered Communications Distribution Designer.
L.	SCS:	Structured Cabling System: SCS is defined in this document as all required horizontal category 6 cabling including associated hardware, patch panels, BDF/IDF patch cords, information outlets, faceplates, work area patch cords, installed and configured to provide telephone and/or computer data network connectivity.
M.	TGB:	Telecommunications Grounding Busbar (IDF locations).
N.	TMGB:	Telecommunications Main Grounding Busbar (BDF location).

O. UTP: Un-shielded twisted pair cable.

1.6 **SUBMITTALS**

A. Provide Product Data: For each type of product indicated.

1. For fiber and copper backbone cabling, include the following installation data for each type used:
   a. Nominal OD.
   b. Pair/strand count
   c. Performance rating
   d. Jacket type
   e. Minimum bending radius.
   f. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:

   a. Cable Counts and cable routing.

5. Termination fields: Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Qualification Data: For Installer**,** qualified layout technician, installation supervisor, and field inspector.

D. Reports and Documentation

1. Source quality-control reports.
2. Field quality-control reports.
3. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 AS BUILT DOCUMENTATION

A. The as-built documentation shall also contain the cabling routes taken between the cable tray, conduit and/or J-Hooks and the telecommunications spaces.

1.8 COORDINATION

A. Coordinate layout and installation of backbone communication cabling prior to start of work.

1. Adjust arrangements and locations of distribution frames and racks and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.9 MATERIALS STANDARDS

A. Products, services, and materials provided by the Design-builder shall meet the requirements of the following (latest edition):

1. National Electrical Manufacturer's Association (NEMA).
2. American National Standards Institute (ANSI).
3. Institute of Electrical and Electronic Engineers (IEEE).
4. Underwriter's Laboratories, Inc., (UL) or equivalent.
5. National Electric Code (NEC).
6. National, State, and Local OSHA building and fire codes.
7. TIA/EIA/ Standard TIA/EIA-568-B.1 - Commercial Building Telecommunications Cabling Standard; Part 1: General Requirements.
8. TIA/EIA Standard TIA/EIA-568-B.2 - Commercial Building Telecommunications Cabling Standard; Part 2: Balanced Twisted-Pair Cabling Components.
9. TIA/EIA Standard TIA/EIA-568-B.3 - Optical Fiber Cabling Components Standard.
10. TIA/EIA Standard TIA/EIA-569-A - Commercial Building Standard for Telecommunications Pathways and Spaces.
11. TIA/EIA Standard TIA/EIA-606A Administration Standard for Commercial Telecommunications Infrastructures.
12. TIA/EIA Standard TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.

B. Products, services, and materials provided by the Design-builder shall be new and of high quality and free of faults and defects.

1.10 SYSTEM TESTING

A. Following telephone, data, and fiber optic cable installation and termination at both ends, undertake and record tests to ensure that the cabling system will perform satisfactorily in service. In addition to the tests detailed in this specification, the Design-builder shall carry out any additional tests deemed necessary to ensure the satisfactory operation of the telephone, data, and fiber optic cable systems. The costs of these additional tests shall be borne by the Design-builder.

B. Provide the University Representative with the opportunity to witness all testing. Notify the University Representative in writing seven working days before the date of commencement of the cable tests. On request, the installer shall demonstrate that the test procedure competently identifies the fault conditions being tested for.

C. Complete the tests identified in all of the telephone and data system specifications in accordance with TIA/EIA-568-B.1, B.2 & B.3

D. Personnel shall be competent in and qualified by experience or training for detailed design, installation, and testing of telephone, data, and fiber optic cable systems.

E. The installer shall be responsible for ensuring that any necessary tests and rework to maintain equipment's calibration status are carried out.

F. To support the test procedure, create a printed table of every cable in the building with appropriate columns for each test result and comments.

G. Sign and date each successful series of test results as the tests proceed. As a minimum, each completed page of test results shall be signed and dated once all the tests on that page have been successfully completed and their results recorded.

H. The test documentation shall be available for inspection by the University Representative during the installation period. The original documents (not copies or retyped versions) shall be retain and included as part of the as-built information.

I. Failures detected during the testing shall be duly noted on the test results schedule and rectified. On the fault being rectified, this shall also be noted. These notes shall not be deleted or obliterated.

J. Rectification of all damaged cables shall include replacing damaged cables with new cables in complete runs or remaking poor terminations. In-line cable joints, splices, or distribution points are not acceptable. All damaged cables shall be removed from site.

PART 2 - PRODUCTS AND SYSTEM REQUIREMENTS

2.1 MANUFACTURERS

A. Manufacturers (Campus Standard):

1. Corning, or equal, for Fiber Optic cable and connectors.
2. Erico® Caddy®, or equal, for J-Hook Cable Support Systems and other non-continuous cable supports.
3. Superior Essex® ARMM, or equal, for twisted pair Copper riser distribution cable.
4. Carlon®, or equal, for Innerducts and associated fittings.
5. Leviton, or equal, for Voice Grade Patch Panels riser distribution in data equipment racks.
6. Copper B-Line Flex Tray, or equal, for Wire Basket Cable Tray support system.

2.2 TELEPHONE SYSTEM RISER CABLE

A. Provide one (1) Superior Essex® ARMM 50-Pair Riser Cables #02-100-03, or equal, between BDF 110 wall mount wiring blocks and each IDF 48-port Voice Patch Panel in Data Equipment Rack to include BDF 48-port Voice Patch Panel in Data Equipment Rack. Each cable shall be shielded twisted-pair 24 AWG solid copper conductors, be riser rated and meet or exceed the specifications for Category 3 cables detailed in the EIA/TIA cabling standard for premises horizontal wiring, see copper riser drawing for locations.

B. Provide Systimax® 110 Patch Panel System Backboard(s) between (Horizontal Telephone and Copper Riser) 110 Patch Panel System Terminal Blocks, product no. 188D3, or equal, (no known equal).

C. Ground each end of 50-Pair Riser Cable to TMGB (BDF) or TGB (IDF) with approved Cable Sheath Bonding Clamp and Two-Hole compression lugs with green #6AWG ground wire.

2.3 TELEPHONE SYSTEM 110 WIRING BLOCKS (FOR RISER CABLES)

A. Provide Systimax® 110 Patch Panel System Terminal Blocks, product no. 110 PA2-300FT, or equal, in BDF and each IDF. The wiring blocks shall be fully equipped with five pair, 110C-5 connecting blocks, jumper troughs and transparent label holders.

B. Provide Systimax® 110 Patch Panel System Backboard(s) between (Horizontal Telephone and Copper Riser) 110 Patch Panel System Terminal Blocks, product no. 188D3, or equal, in BDF and each IDF.

2.4 TELEPHONE SYSTEM VOICE GRADE PATCH PANELS (FOR RISER CABLES)

A. Provide one (1) 110-Style Voice Grade 48-Port Patch Panels in BDF and each IDF location in Data Equipment Rack. Terminate 50-Pair Copper Riser distributions cables on Patch Panels. Patch panels shall be Leviton part number 49013-P48, or equal. Panel shall be configured for one or two-pair per port wiring schemes. Rear label shall be provided which delineates between one and/or two pair wiring schemes and shows 25-pair color-coded termination. Patch Panel shall meet ANSI/TIA/EIA-568-B and FCC Part 68 requirements. Patch Panels shall be provided with forty-eight (48) 8 Pin RJ-45 jacks.

Note: On 50-Pair Riser Cable end at BDF and each IDF in Data Equipment Rack, terminate Cables Pairs 1 through 48 (pair-for-port, pair 1 to port 1, pair 2 to port 2, up to pair 48 to port 48) on 48-Port Voice Grade Patch Panels, store (coil) pairs 49 and 50 at rear of patch panel. On other end of 50-Pair Riser Cable, terminate all pairs on wall mount 110 wiring blocks with 110C-5 connecting blocks in BDF.

2.5 TELEPHONE SYSTEM JUMPER WIRE AND TOOL

A. Provide reel of telephone system jumper wire in the Building Distribution Frame Room. Reel shall consist of two unshielded twisted-pair 22 AWG solid copper conductors (i.e., single pair). Each conductor shall have a PVC sheath. The sheath of the two conductors shall be white/blue blue/white differing colors. The wire shall be General Cable, Cross-Connect Wire, or equal. Provide 500 feet of jumper wire. Hand-deliver the jumper wire to the University Representative after the job is completed.

B. Provide two (2) Telephone Termination 66/110 Automatic Impact Tools. Each tool shall be suitable for terminating telephone system feeder and distribution cables at Telephone Termination Frames and telephone outlets. The tool shall also be suitable for installing jumper wire at the telephone termination frames. The tool shall be Fluke Networks D814 Automatic Impact Punch Down Tool with 66 and 110 Blades, or equal. Hand-deliver the tools to the University Representative after the job is completed.

2.6 DATA SYSTEM FIBER OPTIC CLOSET CONNECTOR HOUSINGS (CCH) AND CONNECTOR PANELS

A. Provide 19-inch rack-mountable (2U and 4U) Closet Connector Housings (CCH) that support inter-connect or cross-connect capabilities between outside plant, riser or distribution cables and opto-electronics to include the following capabilities:

1. Shall hold CCH-CP connector panels, cassettes and/or modules that support a variety of field-termination options; e.g. ST, LC, FC connectors and/or splicing/pigtail assemblies.
2. Removable translucent top cover for visibility and ease of access for installation, testing and troubleshooting.
3. Internal and external strain-relief options.
4. EIA hole spacing (1.75-in)
5. Removable front door and field installable lock kit availability for front and rear doors.
6. Provide one (1) Corning CCH-04U, or equal, Rack Mountable Closet Connector Housing in the BDF Telecom Room, Equipment Rack (RR-XX).
7. Provide one (1) Corning CCH-02U, or equal, Rack Mountable Closet Connector Housing in each IDF Telecom Room, Equipment Rack (RR-XX).

B. Provide Closet Connector Housing Panels (CCH-CP) in CCH that support factory-installed or field-installable fiber optic connectors. CCH-CP shall support multimode and single-mode applications in 6, 8, 12, 16 and 24 fiber count options, plus 36, 72, 96 and 144 fiber count options.

1. Provided Corning CCH-CP12-59, or equal, 12-fiber single-mode SC Duplex Closet Connector Panels in BDF and each IDF Telecom Rooms for each 12 fiber single-mode cable.

2.7 OPTICAL FIBER RISER CABLE

A. Provide Optical Fiber Tight-Buffered OS2 Riser Cable consisting of twelve (12) Single-mode fibers that shall have enhanced low-loss and bend-improved fiber technologies, Corning MIC® 012U81-33131-24, or equal, from BDF to each IDF. Riser cable shall be riser rated OFNR and meet application requirements of the NEC® Article 770 and the ICEA S-83-596 test criteria to include UL-1666 flame resistance. Riser cable shall be suitable for riser type environments for intra-building back-bone installations. Fabricate system using manufacturer's standard materials, and in sizes, types, and performance characteristics as indicated. Factory-fabricated, 900 µm tight-buffered, all-dielectric, low-loss, with bend-improved technologies with the following operational and construction features.

Single Multimode Optical Fiber Specifications	
Outer Jacket Color:	Yellow
Flame Rating:	OFNR
Core Diameter:	8.2 µm nominal
Cladding Diameter:	125.0 (± 0.7) µm
Core/Clad Concentricity:	≤ 0.5 µm
Cladding Non-Circularity:	≤ 0.7%
Coated Fiber Diameter:	242 (± 5) µm
Cladding/Coating Concentricity:	≤ 12 µm
Min. Bend Radius Installation:	3.60 in
Min. Bend Radius Operation:	2.40 in
Max. Tensile Strength, Short-Term:	660 N (150 lbf)
Max. Tensile Strength, Long-Term:	200 N (45 lbf)
Maximum Attenuation:	≤ 0.32 dB/km @ 1310 nm
≤ 0.32 dB/km @ 1383 nm	
≤ 0.21 dB/km @ 1490 nm	
≤ 0.18 dB/km @ 1550 nm	
≤ 0.20 dB/km @ 1625 nm	

Maximum Dispersion:	1550 nm ≤18.0 ps/nm•km
	1625 nm ≤22.0 ps/nm•km
Mode-Field Diameter:	1310 9.2 ± 0.4 µm
1550 10.4 ± 0.5 µm	
Point Discontinuity	1310 ≤ 0.05 dB
1550 ≤ 0.05 dB	
Polarization Mode Dispersion (PMD):	
PMD Link Design Value	≤ 0.04 (ps/√km)
Maximum Individual Fiber PMD	≤ 0.1 (ps/√km)

2.8 SINGLE-MODE OPTICAL FIBER CONNECTORS

A. Provide Corning UniCam 95-200-41 SC Fiber Optic Single-mode (OS2) Connectors, or equal, on each end of all fiber optic cable strand(s). SC Connectors shall meet the following specifications:

1.	Approvals & Listing	EIA/TIA 568-B.3
2.	Intermateability:	FOCIS compliant with EIA/TIA 604-10A and IEC61754-20
3.	Product Type:	Field-Installable Connectors
4.	Technology:	No-Epoxy/No-Polish
5.	Fiber Category:	Single-mode (OS2)
6.	Operation:	-40 ^{0}C to 75 ^{0}C exceeding EIA/TIA 568-B.3
7.	Connector Type:	SC
8.	Ferrule Material:	Ceramic
9.	Housing Material:	Composite
10.	Housing Color:	Blue
11.	Boot Color:	Blue
12.	Durability:	≤ 0.2 dB change by 500 rematings, FOTP-21
13.	Temperature Cycling:	≤ 0.3 dB IL, -40 ^{0} to +75^0 C, 21 cycles
14.	Nominal Fiber OD	125 µm
15.	Tensile Strength Jacket Cable:	44 N, change ≤ 0.2 dB, FOTP-6
16.	Tensile Strength 900 µm:	4.9 N, change ≤ 0.2 dB, FOTP-6
17.	Insertion Loss, Typical:	0.2 dB
18.	Insertion Loss, Maximum:	0.5 dB
19.	Reflectance:	≤ -55 dB
20.	Polish:	UPC

2.9 OPTICAL FIBER PATCH CORDS

A. Provide fifteen (15), 6-foot duplex single-mode (SC to LC) fiber optic jumpers (patch cords) for use with Optical System Patch Panels. Each fiber optic jumper shall be a duplex Zipcord Cable. One end shall be terminated with a Duplex SC Ceramic single-mode connector and the other end shall be terminated with a Duplex LC Ceramic single-mode connector. Fiber Optic Jumpers shall be Corning 0472 02G5120 006 F, or equal, and meet the following specifications:

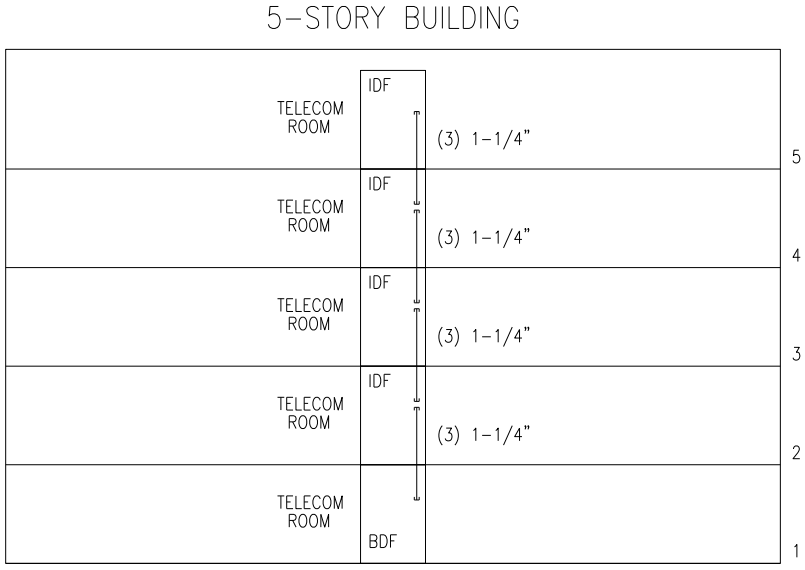
1.	Approvals & Listing	EIA/TIA 568-B.3
2.	Intermateability:	FOCIS compliant with EIA/TIA 604-10A and IEC61754-20
3.	Product Type:	Field-Installable Connectors

4. Technology: No-Epoxy/No-Polish
5. Fiber Category: Bend-improved Single-Mode (OS2)
6. Fiber Type: Single-Mode Ultra-Bendable-Fiber
7. Operation: -40 ^{0}C to 75 ^{0}C exceeding EIA/TIA 568-B.3
8. Zipcord Cable OD / Color: 2.0 mm / Yellow
9. Connector Type: SC and LC
10. Ferrule Material: Ceramic
11. Housing Material: Composite
12. Housing Color: Blue
13. Boot Color: Blue
14. Durability: ≤ 0.2 dB change by 500 rematings, FOTP-21
15. Temperature Cycling: ≤ 0.3 dB IL, -40 ^{0} to +75^0 C, 21 cycles
16. Nominal Fiber OD 125 µm
17. Tensile Strength Jacket Cable: 44 N, change ≤ 0.2 dB, FOTP-6
18. Tensile Strength 900 µm: 4.9 N, change ≤ 0.2 dB, FOTP-6
19. Insertion Loss, Typical: 0.15 dB
20. Insertion Loss, Maximum: 0.25 dB
21. Reflectance (LC & SC): ≤ -59 dB
22. Polish: UPC

2.10 DATA RISER INNERDUCT SYSTEM

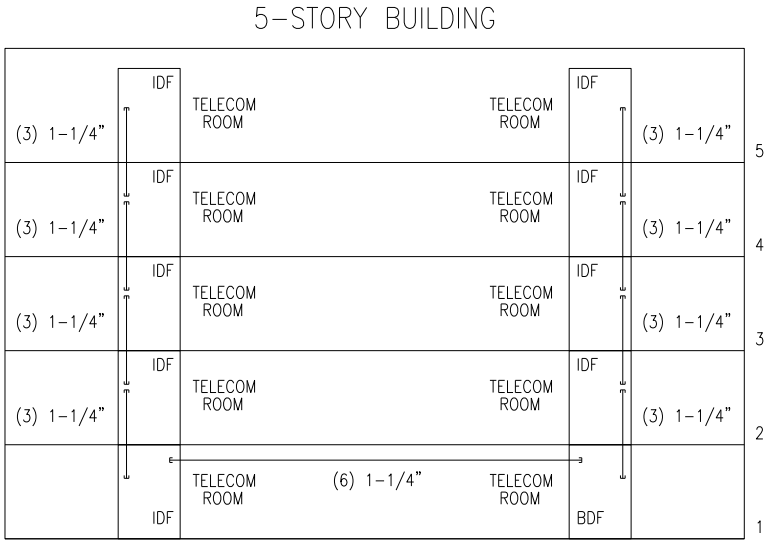
A. Provide Carlon #DG4X1C-xxx one-inch and quarter (1-1/4") Riser-Gard® Innerducts with 900lb Pull Tape, or equal, for fiber optic riser cables.

B. Single Vertical Stacked Riser System: Provide a minimum of three (3) one-inch and quarter (1-1/4") Riser-Gard® Innerducts between each IDF Telecom Room, utilizing one (1) for fiber cables (max 8 fiber cables per Innerduct) and the other two Innerducts to be spare.



SINGLE VERTICAL STACKED RISER SYSTEM
INNERDUCT RISER EXAMPLE

C. Dual Vertical Stacked Riser System: Provide a minimum of three (3) one-inch and quarter (1-1/4") Riser-Gard® Innerducts, or equal, between each IDF Telecom Room in each Riser System utilizing one (1) for fiber cables (max 8 fiber cables per Innerduct) and the other two (2) Innerducts to be spare. Also, provide minimum of six (6) one-inch and quarter (1-1/4") Riser-Gard® Innerducts, or equal, horizontally (ties) between IDF Telecom Room utilizing two (2) for fiber cables (max 8 fiber cables in per Innerduct) and the other four (4) Innerducts to be spare.



DUEL VERTICAL STACKED RISER SYSTEM
INNERDUCT RISER EXAMPLE

2.11 TELEPHONE AND DATA SYSTEM LABELS

A. Provide labels for telephone and data distribution and feeder cables, patch panels and frames, and telephone and data outlets.

B. The lettering on each label shall be as large as is practicable. All labels shall be machine produced. Handwritten labels will not be acceptable.

C. A standard relative orientation shall be adopted for all labels unless otherwise specified.

D. Labels shall be robust, durable, shall resist abrasion, and shall be UV inhibiting, permanent and indelible. Labels shall be proof to 140° Fahrenheit.

E. Labels shall be readily visible and shall be fixed so that they remain in a visible position wherever practical.

F. Labels shall carry the full complement of characters to designate the unique identification for the item that they identify.

G. Cable Labels: Provide Self-Laminating Vinyl (wrap-around type) Cables Labels Brady Corporation, or equal. Cable Labels shall have a white printing area with black print. Cables Labels shall be preprinted or computer printed type. Cable Labels shall meet the legibility,

defacement, exposure and adhesion requirements of UL 969. Hand written Labels are not acceptable.

H. Termination Frame (110 Blocks and Patch Panels) Labels. Provide pre-printed labels on card for 110 blocks. Label each frame on the front, enabling terminations to be clearly identified. Cable terminations on frames shall be uniquely labeled in strict numerical order with the lowest numbered cable to the top left of the allocated portions of the frame.

2.12 TELEPHONE DATA SYSTEM NON-CONTINUOUS J-HOOK CABLE SUPPORTS

A. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; UL Listed. Non-continuous cable supports shall have flared edges to prevent damage while installing cables. Non-continuous cable supports sized 1-5/16-inch and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces. No larger than two-inch (2") max will be allowed for non-continuous cable supports.

2.13 TELEPHONE DATA SYSTEM WIRE BASKET CABLE TRAY SUPPORT PATHWAYS

A. Except as otherwise indicated, provide wire basket cable tray support system, Cooper B-Line Flex Tray, or equal, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

B. Pre-galvanized Zinc Finish: Straight sections, fitting side rails, rungs, and covers shall be made from carbon steel wire meeting the minimum mechanical properties in accordance with ASTM A641 SS for Zink-Coated (Galvanized) Carbon Steel Wire.

C. Provide wire basket cable tray of types and sizes necessary with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces in compliance with applicable standards.

D. Wire basket cable tray systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.

E. All straight section longitudinal wires shall be constructed with a continuous top wire safety edge. Safety edge must be kinked and T-welded on all tray sizes.

F. Wire basket cable tray shall be made of high strength steel wires and formed into a standard 2 inch by 4-inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.

G. All fittings shall be field formed from straight sections in accordance with manufacturer's instructions.

H. Wire basket cable tray supports shall be trapeze type hangers or wall brackets supplied by manufactured. No center type support hanger will be allowed

I. Wire basket cable tray system installation shall be per manufacture directions and shall meet all seismic requirements. Use the proper installation tools; e.g. Cleanshear™ or Angular Bolt Cutters for cutting tools.

J. Provide all special accessories (e.g. radius shields, cable drop outs, cable rollers, etc.) and fittings as required to protect, support and install a wire basket cable tray system.

K. Wire basket sizes shall have 4-inch minimum usable load depth.

L. All fittings must have a minimum radius of 12 inches.

2.14 GROUNDING AND BONDING

A. Materials: Comply with NFPA 70, TIA/EIA-607, and UL 467.

2.15 IDENTIFICATION PRODUCTS

A. Manufacturers:

1. Brady Corporation, Inc.
2. Panduit Corp.
3. Hellerman-Tyton
4. Kroy LLC.

B. Comply with TIA/EIA-606-A Class 3 and University Standards for Telecom Identification.

C. Cable Labels: Self-Laminating Vinyl Cables Labels, machine printed with alphanumeric cable designations.

2.16 SOURCE QUALITY CONTROL

A. Each Fiber-Optic Cable (all strands) shall be tested at factory before shipping at 1310 and 1550 nm for Single mode.

PART 3 - EXECUTION

3.1 INSTALLATION STANDARDS

A. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

B. Installation and certification of all unshielded twisted pair (UTP) cabling in accordance with the latest available TIA/EIA requirements for cabling installations is required.

C. Cabling Systems and Pathways shall be installed in a “neat and workmanlike manner” as specified by ANSI/NECA/BICSI 568-2001 and National Electrical Code (NEC) Sections 110-12 and 800-6.

D. The Design-builder shall adhere to and comply with the latest versions and/or revisions of each applicable standard. Among the various standards, guide-lines and practices applicable to this project are the following:

1. Building Industry Consulting Services International (BICSI)
2. BICSI Telecommunications Distribution Methods Manual (TDMM 11th edition)
3. California Building Standards Commission
4. California Electrical Code (2004) Title 24, Part 3
5. Federal Communications Commission (FCC)
6. FCC Part 68.5 Establishment of Telephone Premises Wiring Attestation List
7. Insulated Cable Engineers Association (ICEA)
8. National Electrical Manufacturers Association (NEMA)
9. NEMA WC 66 (2001) Premise Wiring
10. National Fire Protection Association (NFPA)
11. NFPA 70 (2008) National Electrical Code
12. Telecommunications Industry Association / Electronic Industries Alliance (EIA)
13. TIA/EIA-526-14A (August 1998) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14
14. TIA/EIA-568-B.1 (2004) Commercial Building Telecommunications Wiring Standard
15. TIA/EIA-568-B.2 (2003) Commercial Building Telecommunications Wiring Standard
16. TIA/EIA-568-B.3 (2002) Optical Fiber Cabling Components Standard (ANSI/TIA/EIA-568-B.3-2000)
17. TIA/EIA-569-A (1998) Commercial Building Standard for Telecommunications Pathways and Spaces (ANSI/TIA/EIA-569-A-98)
18. TIA/EIA-569-A-2 (2000) Commercial Building Standard for Telecommunications Pathways and Spaces, Addendum 2 (ANSI/TIA/EIA-569-A-2-2000). This addendum defines the furniture pathways and spaces contained in work areas.
19. TIA/EIA-606-A (2002) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
20. ANSI/J-STD-607-A (2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
21. TIA/EIA – 758 (April 1999) Customer-Owned Outside Plant Telecommunications Cabling Standard
22. UNDERWRITERS LABORATORIES INC. (UL)
23. UL 444 (1994; R 1995, Bul. 1995 and 1996) Communications Cables
24. UL 467 (1993; Bul. 1994 and 1996, R 1996) Grounding and Bonding Equipment
25. UL 497 (1995) Safety Protector for Paired Conductor Communication Circuit
26. UL 514C (1988; R 1989, Bul. 1993 and 1994) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
27. UL 910 (1995; R 1995, Bul. 1995 and 1996) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
28. UL 969 (1995) Marking and Labeling Systems
29. UL 1286 (1993) Office Furnishings
30. UL 1581 (1991; Bul. 1993, 1994, 1995, and 1996, R 1996) Electrical Wires, Cables, and Flexible Cords
31. UL 1666 (1991; Bul. 1995 and 1996) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts
32. UL 1863(1995) Communication Circuit Accessories

E. Federal, state, local codes, rules, regulations, and ordinances governing the work shall be incorporated as part of these Technical Specifications.

F. In reviewing the various Contract Documents, the Design-builder shall be responsible for resolving conflicts between proposed design/concepts and the applicable standards, guidelines and practices.

3.2 EXAMINATION

A. Examine pathway elements intended for cables.

1. Verify proposed routes of pathways. Check raceways, cable trays, J-Hooks, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
2. Identify plan to support cables in suspended and/or open ceilings from the cable tray, conduits sizes and/or J-Hooks to the workstation locations. Verify that load capacity of cable support structures is adequate for each pathway.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 APPLICATION OF MEDIA

A. Backbone Fiber Optic Distribution Cable for Data Service: Use 8.3/125 single-mode fiber-optic cable for runs between the BDF and each IDF's.

B. Backbone Copper Cable for Voice Service: Use Listed (as required for installation) category 3 cable for runs between the BDF and each IDF's.

3.4 TELEPHONE SYSTEM INSTALLATION DETAILS

A. Telephone System Riser Cables:

1. Provide telephone system riser cables between the telephone system 110 wall mount block located in the BDF Telecom Room and each voice grade patch panel (data equipment rack) of the IDF Rooms on each floor. Terminate all pairs of feeder cable in sequential order on the 110 block with 110C-5's on BDF side and pairs 1 thru 48 on IDF voice grade patch panel side.

B. Telephone System Cross-Connects:

1. All Telephone System Cross-Connects will be completed by the University. Coordinate installation needs with University Representative in a timely manner as to not create a scheduling problem.

3.5 DATA SYSTEM INSTALLATION DETAILS

A. Data System Riser Cabling:

1. Provide data system optical fiber riser cabling running between the optical fiber termination unit connector panel(s) in the BDF Telecom Room and the fiber optical termination unit connector panel(s) located in each floor IDF Telecom Room.

3.6 INSTALLATION PRACTICE

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceway and using conduit, J-Hooks and/or cable tray except within consoles, cabinets, desks, and counters and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

C. Cable Installation:

1. Install cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
2. Make terminations only at indicated outlets, terminals, and cross-connect and/or patch panels.
3. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
4. Secure and support cables at intervals 36" to 48" and not more than 6" from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install UTP cables using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

D. Wiring within Wiring Closets and Enclosures:

1. Use cable strain relief brackets behind all patch panels to prevent straining connections to prevent bending cables to smaller radii than minimums recommended by manufacturer.

E. Separation from EMI Sources: Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:

1. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: 24 inches.

2. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches.

b. Electrical Equipment Rating between 2 and 5 kVA: 6 inches.
c. Electrical Equipment Rating More Than 5 kVA: 12 inches.

3. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
b. Electrical Equipment Rating between 2 and 5 kVA: 3 inches.
c. Electrical Equipment Rating More Than 5 kVA: 6 inches.

4. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches.
5. Fluorescent Fixtures: 5 inches.

F. Do not untwist more than 1/4 inch of Category 6 cables at connector terminations

G. Provide grommets and strain-relief for cables terminating on wall-mounted user outlets to ensure durable and robust connections. Leave a 4" slack loop in each cable neatly coiled in the back box at each termination point.

H. Take due account of the minimum bend radius of all cables installed. No cables shall be installed in a fashion that contravenes the minimum bend radius of the cable.

I. Provide all cables in straight parallel runs when on cable trays and/or J-hooks. Hold cables running in the vertical direction in place with broad cable ties at not more than 15" centers. Hold cables running in the horizontal direction in place with broad cable ties at no more than 32" centers.

J. Telephone and data system cables shall run in dedicated cable tray, J-hooks and/or conduit provided for data and telephone system use only. Do not tie communication system cables to power or other foreign services. All cabling shall run parallel or at right angles to building wall structures.

K. Reinstate all pull-wires in conduits after use to facilitate future addition of cables.

L. Provide and install firestopping in accordance with all local and NFPA regulations to sustain ratings when passing through (floors, wall or ceilings) with; conduits, sleeves, raceway, cable tray, wire basket cable tray through fire-rated elements.

M. Install all cables in complete runs from outlet or patch panel to patch panel. In-line joints, splices, distribution points, or other intermediate connections are not permitted.

N. The Design-builder shall individually and properly ground all voice termination frames, data system equipment racks, copper riser sheaths and cable runway with #6AWG green stranded wire to the TMGB or TGB using two-hole compression lugs on each end.

3.7 WIRE BASKET CABLE TRAY INSTALLATION

A. Install wire basket cable tray in accordance with NEMA VE 2 to ensure that the cable tray equipment complies with the requirements of the NEC, applicable portions of NFPA 70B, and

the National Electrical Design-builders Association's (NECA) 'Guide to Quality Electrical Installations' pertaining to general electrical installations practices.

B. Coordinate wire basket cable tray with other electrical work as necessary to properly interface installation of wire basket cable tray with other work.

C. Install expansion connectors where recommended by manufacturer.

D. Comply with the appropriate Division 26 Section for "Grounding and Bonding" and with TIA/EIA 607.

3.8 GROUNDING

A. Comply with the appropriate Division 26 Section for "Grounding and Bonding" and with TIA/EIA 607.

B. Grounding Points:

1. Locate grounding busbars (MTGB) in BDF and (TGB) in each IDF Telecom Rooms.
2. Provide a ground connection from all voice termination frames, data system equipment racks, copper riser sheaths and cable runways to the grounding terminals in the MDF/BDF and IDFs.

3.9 LABELING and numbering CONVENTIONS

A. General.

1. Outlets, cables, and terminations shall be labeled with a standard identification tag. Tags shall be typewritten or stamped with indelible waterproof ink and mechanically secured in a permanent fashion. Handwritten labels are NOT acceptable. Labels shall be mounted in a manner, which permits easy access and viewing. Receptacles, cables, and terminations shall be identified using the following conventions.

B. Outside Plant and Riser Cables:

1. Telephone cable(s) will have cable ID and pair counts, from and to locations clearly marked on each cable and building equipment room punch down blocks.
2. Optical fiber cable will have cable ID and strand count, from and to locations clearly marked on each building equipment room fiber optic patch panel.
3. Label each cable so that the label is visible for inspection.

C. Telephone System Termination 110 Block:

1. Termination 110 Block Labels. Provide a full complement of pre-printed cardboard patch frame labels, allowing each pair of each telephone system distribution, feeder, and external cable to be clearly identified. Telephone feeder cable pairs at terminal frames shall identify telephone outlet that they are connected to via the telephone station cable.

D. Data System Patch Panels:

1. Provide a full complement of data system patch panel labels, allowing each data system distribution and feeder cable connector to be clearly identified. Both copper and fiber connectors shall be labeled.

3.10 IDENTIFICATION

A. Cabling Administration Drawings: Show building floor plans with cable administration-point labeling. Identify labeling convention and show labels for telecom rooms, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings.

3.11 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

B. Category 6 UTP Cabling Tests:

1. Tests shall include all tests of Category 6, conducted from 1 to 250 MHz

2. Channel and permanent link tests shall be performed with a tester that complies with performance requirements in TIA/EIA-568-B.2, Level III. Include tests for longitudinal or transverse conversion loss.

3. Performance shall comply with minimum criteria in TIA/EIA-568-B.1 & B.2.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

3.12 TESTING AND DOCUMENTATION

A. General:

1. Acceptance testing shall be in compliance with TIA/EIA-568-B.1, B.2 & B.3.
2. A University Representative, at the option of the University, shall be present during testing.
3. Such acceptance testing shall in no way reduce the Design-builders' obligations regarding restoration, clean up, or warranty.
4. Design-builder shall be responsible for performing, tracking, and recording the results of tests.

B. Telephone and Data (copper & fiber) BDF to IDF Riser Cables:

1. A visual inspection shall be made to insure that the cables have been terminated on the punch down block in proper color code order. An end-to-end continuity test is to be made for each pair to insure wire continuity and correct tip and ring polarity. Riser cables will be tested from the BDF 110 frame punch down blocks to each IDF Telecom Room patch panel that the cable serves.
2. Vertical and horizontal riser cables will be tested to insure that they meet the current requirements of EIA/TIA cabling standard for premises horizontal wiring for the category of cable being installed, i.e., Category 3 cable shall meet Category 3 parameters within a 25-pair binder group. Documentation will include cable ID; pair ID, from and to points, pair ID marked on the punch down blocks, results of testing, and as-built information.
3. Bad pairs in copper cables shall be limited to a maximum of 0 percent of the total number of pairs.
4. Acceptance testing shall be completed prior to completion of Design-builder's contractual obligations.
5. Documentation will include cable ID, from and to points, strand ID, bi-directional attenuation figures in dB, OTDR wave forms, and as-built information.
6. Use of an OTDR may require that a "launch reel" be used to overcome the OTDR's dead zone. Include this information in the as-build documentation.
7. Fiber jumpers used with the OTDR, light source, and power meter must be of the same size and type as the fiber being tested.
8. Fiber jumpers used with the light source and attaching the jumper from the light source via a coupler to the jumper from the power meter shall zero power meters out. This reading noted will become the reference level to obtain a true attenuation reading (some power meters can be zeroed to allow reading the attenuation level directly).

C. Test Equipment:

1. It will be the Design-builder's responsibility to provide the test equipment necessary and document to the University Representative the test equipment available for testing and the last date of certification.

2. Testing Equipment:

   a. Continuity tester.
   b. Power meter/source.
   c. OTDR (Optical Time Domain Reflectometer).
   d. Appropriate types of fiber jumpers.
   e. Equipment for two testers to communicate.
   f. OmniScanner 2 or Agilent Wirescope 350 or other equal Level III tester.

D. Documentation:

1. The Design-builder shall submit three (3) copies (drawings hard copy 24" x 36" and Compact Disc) of the following as-built record drawings and documentation in a 3-ring binder following completion of testing (and re-certification, as necessary):

   a. Construction Drawings: The as-built documentation shall be in AutoCAD min R2004 dwg or dxf equal and shall consist of the construction drawings with the station location numbers (faceplate identification numbers, e.g. 1A-V12, 1A-C15, etc.) inserted next to

the symbol for each location. Also, Equipment Rack and Wall elevations to include Copper and Fiber riser diagrams shall be provided.

b. Fiber Optic Riser Test reports (OTDR and Power Meter).
c. Copper riser Test reports (Cable No. and pair counts: opens, shorts, grounds, etc.).
d. Cat-6 Test reports to be provided in pdf file format and shall include and be arranged in:

1. Overall Summary Page (numerical order)
2. Telecom Room (BDF/IDF), Patch Panel (A thru Z) (numerical order)

END OF SECTION 27 1300

SECTION 27 1500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The work shall consist of the provision, termination, and testing of complete and fully-functional Structured Cabling System (SCS) for telephone and data system network. This work shall include provision of but not limited to the following:

1. Telephone and data system patch panels and associated hardware.
2. Telephone and data system horizontal station cables.
3. Telephone and data system connectors and faceplates.

B. The work shall not include provision of the following:

1. Telephone handsets and active switching equipment.
2. Integrated Services Digital Network equipment.
3. Telephone services or active computer and networking equipment.
4. Computer and network software.
5. Copper and Fiber entrance cables, air blown fiber (ABF) bundles and tube cables.

C. Provide all incidental items that belong to the Work described and which are required for a complete system.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Wire Basket cable tray system, raceways, conduits and boxes, external duct bank tie and other components that make up the infrastructure pathways that will carry the telephone and data cabling shall be furnished and installed by the electrical Design-builder.

C. Section 01 91 13 - General Commissioning Requirements.

1.3 QUALIFICATIONS

A. Manufacture:

1. The SCS specified products for the horizontal cabling (e.g. Cat-6 cable, patch panels, information outlets, faceplates, jacks, patch cords, etc.) shall be supplied by a single manufacturer.
2. Manufacturer shall have a minimum of ten (10) years of experience in the manufacture of the specified cabling products and shall be ISO 9001/14000 Certified.

B. Installer:

1. Installer shall be certified by the manufacture company in all aspects of design, installation and testing of the SCS horizontal cabling specified products.
2. The installer shall utilize the authorized SCS manufacturer horizontal cabling components and distribution channels in provisioning this Project.
3. Installer shall own and maintain tools and equipment approved by the cabling system manufacturer for installation and testing of the SCS Category 6 horizontal cabling balanced twisted pair distribution systems.
4. SCS Installer shall carry out the telephone and data network system installation work detailed in this specification.
5. SCS Installer shall have a proven track record in the field of telephone, data, and fiber cabling and system installation, with at least five previous installations of comparable size and complexity undertaken within the last five years.
6. Installer shall be qualified in the installation and termination of optical fiber cabling as described in this specification.
7. A specialist installer company that has completed work of a similar nature shall carry out the telephone and data system installation work detailed in this specification.
8. Installer shall be an authorized CommScope Systimax® Business Partner and shall provide the CommScope Systimax® Solutions 20 year extended product warranty and application assurance on this installation.

1.4 SUMMARY

A. This Section includes the following items for wiring systems used as signal pathways for voice and high-speed data transmission:

1. Mounting elements.
2. Un-shielded twisted-pair cabling.
3. Workstation outlets.
4. Identification products.

1.5 DEFINITIONS

A. Backbone: A facility (e.g., pathway, cable, or conductors) between telecommunications rooms or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.
B. BDF: Building Distribution Frame.
C. BICSI: Building Industry Consulting Service International.
D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
E. EMI: Electromagnetic interference.
F. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. Also the cabling between and including the building automation system outlet or the first mechanical terminations on the horizontal connection point and the horizontal cross-connect.

G. IDC: Insulation displacement connector.
H. IDF: Intermediate Distribution Frame.
I. LAN: Local area network.
J. MDF: Main Distribution Frame.
K. RCDD: Registered Communications Distribution Designer.
L. SCS: Structured Cabling System: SCS is defined in this document as all required horizontal category 6 cabling including associated hardware, patch panels, BDF/IDF patch cords, information outlets, faceplates, work area patch cords, installed and configured to provide telephone and/or computer data network connectivity.
M. TGB: Telecommunications Grounding Busbar (IDF locations).
N. TMGB: Telecommunications Main Grounding Busbar (BDF location).
O. UTP: Un-shielded twisted pair cable.

1.6 SUBMITTALS

A. Provide Product Data: For each type of product indicated.

1. For horizontal cabling include the following installation data for each type used:

a. Nominal OD.
b. Jacket type
c. Performance Rating
d. Minimum bending radius.
e. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:

a. Cable Counts and cable routing.

5. Termination fields: Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Qualification Data: For Installer**,** qualified layout technician, installation supervisor, and field inspector.

D. Reports

1. Source quality-control reports.
2. Field quality-control reports.

1.7 AS BUILT DOCUMENTATION

A. As-built documentation shall consist of all the construction drawing floor plans with the telephone and/or data outlet station location numbers (faceplate identification numbers, e.g. 1A- V12, 1A-C15, etc.) inserted next to the telephone and/or data symbols for each location.

B. The as-built documentation shall also contain the cabling routes taken between the cable tray, conduit and/or J-Hooks and the workstation outlets.

1.8 COORDINATION

A. Coordinate layout and installation of voice and data communication cabling prior to start of work.

1. Adjust arrangements and locations of distribution frames and racks and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.9 MATERIALS STANDARDS

A. Products, services, and materials provided by the Design-builder shall meet the requirements of the following (latest edition):

1. National Electrical Manufacturer's Association (NEMA).
2. American National Standards Institute (ANSI).
3. Institute of Electrical and Electronic Engineers (IEEE).
4. Underwriter's Laboratories, Inc., (UL) or equivalent.
5. National Electric Code (NEC).
6. National, State, and Local OSHA building and fire codes.
7. TIA/EIA/ Standard TIA/EIA-568-B.1 - Commercial Building Telecommunications Cabling Standard; Part 1: General Requirements.
8. TIA/EIA Standard TIA/EIA-568-B.2 - Commercial Building Telecommunications Cabling Standard; Part 2: Balanced Twisted-Pair Cabling Components.
9. TIA/EIA Standard TIA/EIA-568-B.3 - Optical Fiber Cabling Components Standard.
10. TIA/EIA Standard TIA/EIA-569-A - Commercial Building Standard for Telecommunications Pathways and Spaces.
11. TIA/EIA Standard TIA/EIA-606A Administration Standard for Commercial Telecommunications Infrastructures.
12. TIA/EIA Standard TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.

B. Products, services, and materials provided by the Design-builder shall be new and of high quality and free of faults and defects.

1.10 SYSTEM TESTING

A. Following telephone, data, and fiber optic cable installation and termination at both ends, undertake and record tests to ensure that the cabling system will perform satisfactorily in service. In addition to the tests detailed in this specification, the Design-builder shall carry out any additional tests deemed necessary to ensure the satisfactory operation of the telephone, data, and fiber optic cable systems. The costs of these additional tests shall be borne by the Design-builder.

B. Provide the University Representative with the opportunity to witness all testing. Notify the University Representative in writing seven working days before the date of commencement of

the cable tests. On request, the installer shall demonstrate that the test procedure competently identifies the fault conditions being tested for.

C. Complete the tests identified in all of the telephone and data system specifications in accordance with TIA/EIA-568-B.1, B.2 & B.3

D. Personnel shall be competent in and qualified by experience or training for detailed design, installation, and testing of telephone, data, and fiber optic cable systems.

E. The installer shall be responsible for ensuring that any necessary tests and rework to maintain equipment's calibration status are carried out.

F. To support the test procedure, create a printed table of every cable in the building with appropriate columns for each test result and comments.

G. Sign and date each successful series of test results as the tests proceed. As a minimum, each completed page of test results shall be signed and dated once all the tests on that page have been successfully completed and their results recorded.

H. The test documentation shall be available for inspection by the University Representative during the installation period. The original documents (not copies or retyped versions) shall be retain and included as part of the as-built information.

I. Failures detected during the testing shall be duly noted on the test results schedule and rectified. On the fault being rectified, this shall also be noted. These notes shall not be deleted or obliterated.

J. Rectification of all damaged cables shall include replacing damaged cables with new cables in complete runs or remaking poor terminations. In-line cable joints, splices, or distribution points are not acceptable. All damaged cables shall be removed from site.

PART 2 - PRODUCTS AND SYSTEM REQUIREMENTS

2.1 MANUFACTURERS

A. Manufacturers (Campus Standard):

1. CommScope Systimax®, or equal, for Category 6 (voice and data) horizontal structured cabling system.
2. Corning, or equal, for Fiber Optic cable and connectors.
3. Erico® Caddy®, or equal, for J-Hook Cable Support Systems and other non-continuous cable supports.
4. Leviton, or equal, for Voice Grade Patch Panels riser distribution in data equipment racks.

2.2 TELEPHONE AND DATA SYSTEM HORIZONTAL STATION CABLING

A. Provide Systimax® 2071E GigaSPEED® Category 6 / Class E (campus standard), or equal, plenum cable. Each cable shall have eight unshielded twisted-pair 24 AWG solid copper conductors (i.e., four pairs), be plenum rated, color white (telephone), color blue (data) and meet or exceed the specifications for Category 6 cables detailed in the EIA/TIA cabling standard for premises horizontal wiring to include:

1. Category 6 cable and all Category 6 channel components shall be manufactured by a single manufacture.
2. Category 6 UTP balanced twisted pair cable and apparatus channel performance shall be guaranteed up to the maximum 100 meters (328 feet) length, including up to 6 connection points and shall meet the following Guaranteed Channel Performance Specifications for 6-Connection High Performance Category 6 Systems:

Guaranteed Channel Performance Specifications for 6-Connection GigaSPEED XL7 Channels

Frequency (MHz)	**1**	**4**	**8**	**10**	**16**	**20**	**25**	**31.25**	**62.5**	**100**	**200**	**250**
Insertion Loss (dB)	2.1	3.9	5.4	6.1	7.7	8.7	9.7	10.9	15.8	20.4	30.3	34.5
NEXT (dB)	69.0	67.0	62.2	60.6	57.2	55.6	54.0	52.4	47.4	43.9	38.8	37.1
ACR (dB)	66.9	63.2	56.7	54.5	49.5	47.0	44.3	41.5	31.6	23.5	8.5	2.6
PSNEXT (dB)	67.5	66.0	61.1	59.5	56.1	54.5	52.8	51.2	46.1	42.6	37.4	35.7
PSACR (dB)	65.4	62.1	55.7	53.4	48.4	45.8	43.1	40.3	30.3	22.1	7.1	1.2
ELFEXT (dB)	67.3	55.2	49.2	47.3	43.2	41.2	39.3	37.4	31.3	27.3	21.2	19.3
PSELFEXT (dB)	66.3	54.2	48.2	46.3	42.2	40.2	38.3	36.4	30.3	26.3	20.2	18.3
Return Loss (dB)	21.0	21.0	21.0	21.0	20.0	19.5	19.0	18.5	16.0	14.0	11.0	10.0
Delay (ns)	580	562	557	555	553	552	551	550	549	548	547	546
Delay Skew (ns)	30	30	30	30	30	30	30	30	30	30	30	30

Note: The table provides reference values only. All parameters comply with the governing equations

given below over the entire frequency range. All values and equations apply to worst-case channels utilizing four-pair 71E series cables with up to 6 embedded connections in a channel for any channel lengths up to 100 meters.

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category 6 / Class E Channel Specifications
Insertion Loss	4 %
NEXT	4 dB
PSNEXT	5.5 dB
ELFEXT	4 dB
PSELFEXT	6 dB
Return Loss	2 dB

Governing Equations for 6-Connection Premium Performance Channels (1-250MHz):

$$Insertion\ Loss \le 1.8472 \times \sqrt{f} + 0.0166 \times f + \frac{0.1958}{\sqrt{f}} + 2.88 \times 10^{-4} \times f^{1.5}$$

$$NEXT \ge -\left\lceil 20 \times \log\left(1.2162 \times 10^{-4} \times f^{0.75} + 2.5179 \times 10^{-5} \times f \right) \right\rceil$$

$$PSNEXT \ge -\left\lceil 20 \times \log\left(1.1482 \times 10^{-4} \times f^{0.75} + 2.9925 \times 10^{-5} \times f \right) \right\rceil$$

$$ELFEXT \ge -\left\lceil 20 \times \log\left(4.3367 \times 10^{-4} \times f \right) \right\rceil$$

$$PSELFEXT \ge -\left\lceil 20 \times \log\left(4.8658 \times 10^{-4} \times f \right) \right\rceil$$

$$RL \ge 21,\ 1 \le f < 10\ MHz; \quad RL \ge 26 - 5 \times \log(f),\ 10 \le f < 40\ MHz; \quad RL \ge 34 - 10 \times \log(f),\ 40 \le f < 250\ MHz$$

$$Delay \le 544 + \frac{36}{\sqrt{f}}; \quad Skew \le 30$$

3. Cable Specifications for GigaSPEED® 2071E:

Nominal Outer Jacket OD:	0.224 in
Nominal Outer Jacket Thickness:	0.020 in
Maximum Pulling Tension:	25 lbs.
Nominal Cable Weight:	29.1 lbs./1,000 ft.
Operating Temperature:	-4°F to 140°F
Installation Temperature:	32°F to 140°F
Conductor Diameter:	23 AWG
Jacket Material:	Low Smoke PVC
ETL Listed Type:	CMP
Nominal Velocity of Propagation:	71%
Maximum DC Resistance	7.61 Ohms/100 m
Maximum DC Resistance Unbalanced:	3%
Maximum Mutual Capacitance at 1 KHz:	5.6 nF/100 m
Minimum Dielectric Strength:	1500 VAC or 2500 VDC
Voltage Safety Rating:	300 Volts per NEC 800.179

2.3 TELEPHONE AND DATA SYSTEM INFORMATION OUTLETS

Provide a Category 6 eight-position information outlet for each telephone and/or data system outlet. The outlets shall be capable of supporting telephone (analog and digital) and/or data services. The outlets shall allow the cable to terminate directly onto the connector with no intermediate cable "tails" or other untwisted links. The information outlets shall be Systimax® MGS400-270, (Grey for voice), MGS400-003, (Black for data), or equal. Category 6 outlets shall meet the following Guaranteed Margin Performance and Physical Specifications:

Guaranteed Margin Performance:

	Category 6 Outlet	High Performance Channel (4 Connections)	Premium Performance Channel (4 Connections)
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	26.9%	5.0%	7.5%
NEXT	5.4 dB	6.0 dB	7.0 dB

PSNEXT	4.7 dB	7.5 dB	8.5 dB

ELFEXT	10.5 dB	6.0 dB	8.0 dB
PSELFEXT	10.8 dB	8.0 dB	10.0 dB
Return Loss	8.0 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin when measured with same manufacture's Category 6 modular patch cord.

**Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Category 6 apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

Physical Specifications:

Dimensions	0.8 in (20 mm) W x 0.8 in (20 mm) H x 1.2 in (31 mm) D
Plastic	High-impact, flame-retardant, UL rated 94V-0 thermoplastic
Connector	Copper alloy, 100 micro-inch bright solder over 100 micro-inch nickel underplate
Outlet Wires	Copper alloy, 50 micro-inch lubricated gold plating over 100 micro-inch nickel underplate
Operating Temperature	14°F to 140°F (-10°C to 60°)
Storage Temperature Range	-40°F to 158°F (-40°C to 70°C)
Humidity	95% (noncondensing)
Nominal Solid Conductor Diameter:	0.025 to 0.020 in (22 to 24 AWG)
Nominal Stranded Conductor Diameter	0.64 to 0.51mm (22 to 24 AWG)
Plug Retention Force	30lb (133 N) minimum
Plug / Jack Contact Force	100 grams minimum per contact using FCC-8 position telecommunication plug
Insertion Life	750 cycles minimum using FCC-8 position telecommunication plug

2.4 TELEPHONE SYSTEM 110 WIRING BLOCKS (FOR RISER CABLES)

A. Provide Systimax® 110 Patch Panel System Terminal Blocks, product no. 110 PA2-300FT, or

equal, in BDF and each IDF. The wiring blocks shall be fully equipped with five pair, 110C-5 connecting blocks, jumper troughs and transparent label holders.

B. Provide Systimax® 110 Patch Panel System Backboard(s) between (Horizontal Telephone and Copper Riser) 110 Patch Panel System Terminal Blocks, product no. 188D3, or equal, in BDF and each IDF.

2.5 TELEPHONE SYSTEM JUMPER WIRE AND TOOL

A. Provide reel of telephone system jumper wire in the Building Distribution Frame Room. Reel shall consist of two unshielded twisted-pair 22 AWG solid copper conductors (i.e., single pair). Each conductor shall have a PVC sheath. The sheath of the two conductors shall be white/blue blue/white differing colors. The wire shall be General Cable, Cross-Connect Wire, or equal. Provide 500 feet of jumper wire. Hand-deliver the jumper wire to the University Representative after the job is completed.

B. Provide two (2) Telephone Termination 66/110 Automatic Impact Tools. Each tool shall be suitable for terminating telephone system feeder and distribution cables at Telephone Termination Frames and telephone outlets. The tool shall also be suitable for installing jumper wire at the telephone termination frames. The tool shall be Fluke Networks D814 Automatic Impact Punch Down Tool with 66 and 110 Blades, or equal. Hand-deliver the tools to the University Representative after the job is completed.

2.6 TELEPHONE AND DATA SYSTEM FACEPLATES

A. Provide a flush-mounted modular faceplate to house data and telephone system connectors, capable of housing a minimum of six (6) information outlets. The faceplate shall fit over a standard NEMA electrical outlet box (4S) with a single-gang plaster ring, and shall allow information outlets to be snapped into the faceplate with the nose flush to the plate surface. The faceplate shall be Systimax® M16L 6 port single gang wall plate or equal, (match color of electrical plates), or equal.

B. Provide modular faceplates suitable for Modular Furniture to support data and telephone system connectors, capable of housing a minimum of three (3) information outlets. The faceplate shall be compatible to fit modular furniture raceway. Provide bezel(s) and all associated hardware as required. The faceplate shall be Systimax® M13C series triplex outlets, match color of electrical plates, or equal.

C. Blanking Plates. Provide blanking plates to be installed in faceplate outlet positions that are not populated with telephone and/or data system information outlets. Provide blanking plates in sufficient quantities to cover all unused openings in every faceplate. The blanking plate shall be Systimax® M20AP blank module or equal, (match color of telephone / data plate).

D. At Wall (+42" AFF) Phone Outlet locations. Provide Stainless Steel Faceplate suitable for wall mount phone, equipped with an six-position connector, RJ45 connector with screw terminations, faceplate shall be stainless steel wall plate.

2.7 TELEPHONE AND DATA SYSTEM OUTLET MOUNTING COLLARS

A. Provide a flush-mounted modular mounting collar to house data and/or telephone system

information outlets at fixed or mobile the lab benches. The mounting collar shall fit in a pre-punched opening, and shall allow connectors to be snapped into the mounting collar with the nose flush to the collar surface. The mounting collar shall be Systimax® M30MC Mounting Collar or equal, (match color of electrical plates) or equal.

2.8 TELEPHONE AND DATA SYSTEM MODULAR PATCH PANELS

A. Telephone and Data System Modular Patch Panels:

1. Provided Systimax® 1100GS3 CAT-6 48 port patch panels for telephone and data cables, product 1100GS3-48, or equal, with 110 IDC connector terminations on rear. Patch Panel shall meet the following specifications: (See Item 2.3 for information outlet specifications.)

Performance Specifications:

	Category 6 Patch Panel	High Performance Solution	Premium Performance Solution
		Category 6 Channel (4 Connectors)	
	Typical Worst Pair Margin*	**Guaranteed Margin****	**Guaranteed Margin****
Insertion Loss	64.3%	5.0%	7.5%
NEXT	6.6 dB	6.0 dB	7.0 dB
PSNEXT	7.3 dB	7.5 dB	8.5 dB
ELFEXT	6.4 dB	6.0 dB	8.0 dB
PSELFEXT	6.1 dB	8.0 dB	10.0 dB
Return Loss	6.6 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin when measured with a GS8E modular patch cord.

**Guaranteed margin is valid at any frequency from 1-250 MHz for a SYSTIMAX® certified channel comprising GigaSPEED XL apparatus and 71E series cable (GigaSPEED XL7 Solution). Values represent margin over the draft Category 6/Class E channel specifications.

Physical Specification:

48 Port Patch Panel	19.0 x 5.25 x 1.25 in (48.26 x 13.34 x 3.20 cm) - 3 Rack Unit Universal A/B labeling
Operating Temperature Range	14°F to 140°F (-10°C to 60°C)
Storage Temperature Range	-40°F to 158°F (-40°C to 70°C)
Humidity	95% (noncondensing)

Nominal Solid Conductor Diameter	0.016 to 0.025 in (0.40 to 0.64 mm) (22 to 24 AWG)
Nominal Stranded Conductor Diameter	0.020 to 0.025 in (0.51 to 0.64 mm (22 to 24 AWG)
Insulation Size	0.046 in (1.17 mm) (22 to 24 AWG) Maximum

	DOD
Insulation Types	All plastic insulates (including PVC, irradiated PVC Polyethylene, Polypropylene
PTF Polyurethane Nylon	and FEP
Modular Jack Insertions	750 minimum insertions of an FCC 8-Position Telecommunications Plug
Front Panel	Black powder painted steel.
Modular Panels	High-impact, flame retardant UL-rated 94V-0 thermoplastic

Operational Specifications:

Operating Temperature Range:	14°F to 140°F (-10°C to 60°C)
Storage Temperature Range:	-40°F to 158°F (-40°C to 70°C)
Humidity:	95% (noncondensing)
Nominal Solid Conductor Diameter:	0.016 to 0.025 in (0.40 to 0.64 mm) (22 to 24 AWG)
Nominal Stranded Conductor Diameter:	0.020 to 0.025 in (0.51 to 0.64 mm (22 to 24 AWG)
Insulation Size:	0.046 in (1.17 mm) (22 to 24 AWG) Maximum DOD
Insulation Types:	All plastic insulates (including PVC,irradiated PVC, Polyethylene, Polypropylene, PTF Polyurethane, Nylon, and FEP)
Insertion Life :	750 minimum insertions of an FCC 8-Position Telecommunications Plug
Front Panel:	Black powder painted steel.
Plastic:	High-impact, flame retardant, UL-rated 94V-0 thermoplastic

2. Terminate Telephone and Data Cat-6 cables on separate 48 Port Patch Panels, do not mix terminations.
3. Patch Panel shall have strain relief (rear wire management bars) for each cable terminated on the connector.
4. Patch Panel shall be UL listed, UL-C certified and ACA approved.
5. Patch Panel 19-inch rack mountable and be able to store cable reserve with no bends sharper

than 2" bend radius.

6. Provide sufficient finger space to allow connectors to be mounted and demounted easily.
7. Provide Space for labeling of each individual copper connector.
8. Shall allow any individual cable to be terminated or otherwise handled without disturbing other cables.

2.9 TELEPHONE AND DATA SYSTEM PATCH CORDS

A. Provide (1) four-pair Systimax® CPC3312-03Fxxx GigaSPEED XL CAT 6 Patch Cord, or equal, for each telephone and data system information outlet installed in the project. (Note: xxx is length of patch cord, see item 2 below). Each patch cord shall have eight unshielded twisted-pair 24 AWG stranded copper conductors (i.e., four pairs), meeting the specifications for Data System Distribution Cabling and as detailed in this specification. Each patch cord shall be terminated with a Category 6 GS8E RJ45 data system copper connector on each end and meet the following:

1. Category 6 Patch Cord Requirement:

a. All patch cords shall exceed TIA/EIA and ISO/IEC Category 6/Class E specifications.
b. The patch cords shall incorporate an anti-snag feature that provides maximum protection from snagging during moves and re-arrangements.
c. Patch cords shall be UL listed, UL-C certified.
d. Patch cords shall support network line speeds in excess of 1 gigabit per second.
e. Patch cords shall be available in stranded and solid conductor in lengths to 100 feet.
f. Guaranteed Margin:

	Category 6 Modular Patch Cord (4 Pair)	High Performance Channel (4 Connections)	Premium Performance Channel (4 Connections)
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	NA	5.0%	7.5%
NEXT	4.4 dB	6.0 dB	7.0 dB
PSNEXT	NA	7.5 dB	8.5 dB
ELFEXT	NA	6.0 dB	8.0 dB
PSELFEXT	NA	8.0 dB	10.0 dB
Return Loss	5.9 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin to TIA Patch cord specification when measured with same manufacturer's Category 6 telecommunications outlet.
** Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Category 6

apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

2. Provide the following:

   a. 50 percent of Patch Cords shall be Systimax® CPC3312-03F001 GigaSPEED XL CAT 6 Patch Cord, or equal, (No Known Equal).
   b. 25 percent of Patch Cords shall be Systimax® CPC3312-03F003 GigaSPEED XL CAT 6 Patch Cord, or equal, (No Known Equal).
   c. 25 percent of Patch Cords shall be Systimax® CPC3312-03F006 GigaSPEED XL CAT 6 Patch Cord, or equal, (No Known Equal).

3. Deliver all data system Patch Cords to the University Representative.

   a. The Design-builder is not required to install patch cords.

2.10 DATA SYSTEM HORIZONTAL PATCH MANAGEMENT

A. Provide horizontal patch management panel(s) for each Data System Equipment Rack(s). Provide one (1) Panduit WMPHF2E (front pathway only) 2U-high horizontal cable manager(s), or equal, above and below each 48 port patch panel and each 10 Outlet power strip.

2.11 TELEPHONE AND DATA SYSTEM LABELS

A. Provide labels for telephone and data distribution and feeder cables, patch panels and frames, and telephone and data outlets.

B. The lettering on each label shall be as large as is practicable. All labels shall be machine produced. Handwritten labels will not be acceptable.

C. A standard relative orientation shall be adopted for all labels unless otherwise specified.

D. Labels shall be robust, durable, shall resist abrasion, and shall be UV inhibiting, permanent and indelible. Labels shall be proof to 140° Fahrenheit.

E. Labels shall be readily visible and shall be fixed so that they remain in a visible position wherever practical.

F. Labels shall carry the full complement of characters to designate the unique identification for the item that they identify.

G. Cable Labels: Provide Self-Laminating Vinyl (wrap-around type) Cables Labels Brady Corporation, or equal. Cable Labels shall have a white printing area with black print. Cables Labels shall be preprinted or computer printed type. Cable Labels shall meet the legibility, defacement, exposure and adhesion requirements of UL 969. Hand written Labels are not acceptable.

H. Termination Frame (110 Blocks and Patch Panels) Labels. Provide pre-printed labels on card for 110 blocks. Label each frame on the front, enabling terminations to be clearly identified. Cable

terminations on frames shall be uniquely labeled in strict numerical order with the lowest numbered cable to the top left of the allocated portions of the frame.

2.12 GROUNDING AND BONDING

A. Materials: Comply with NFPA 70, TIA/EIA-607, and UL 467.

2.13 IDENTIFICATION PRODUCTS

A. Manufacturers:

1. Brady Corporation, Inc.
2. Panduit Corp.
3. Hellerman-Tyton
4. Kroy LLC.

B. Comply with TIA/EIA-606-A Class 3 and University Standards for Telecom Identification.

C. Cable Labels: Self-Laminating Vinyl Cables Labels, machine printed with alphanumeric cable designations.

PART 3 EXECUTION

3.1 INSTALLATION STANDARDS

A. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

B. Installation and certification of all unshielded twisted pair (UTP) cabling in accordance with the latest available TIA/EIA requirements for cabling installations is required.

C. Cabling Systems and Pathways shall be installed in a "neat and workmanlike manner" as specified by ANSI/NECA/BICSI 568-2001 and National Electrical Code (NEC) Sections 110-12 and 800-6.

D. The Design-builder shall adhere to and comply with the latest versions and/or revisions of each applicable standard. Among the various standards, guide-lines and practices applicable to this project are the following:

1. Building Industry Consulting Services International (BICSI)
2. BICSI Telecommunications Distribution Methods Manual (TDMM 11th edition)
3. California Building Standards Commission
4. California Electrical Code (2004) Title 24, Part 3
5. Federal Communications Commission (FCC)
6. FCC Part 68.5 Establishment of Telephone Premises Wiring Attestation List
7. Insulated Cable Engineers Association (ICEA)
8. National Electrical Manufacturers Association (NEMA)
9. NEMA WC 66 (2001) Premise Wiring
10. National Fire Protection Association (NFPA)

11. NFPA 70 (2008) National Electrical Code
12. Telecommunications Industry Association / Electronic Industries Alliance (EIA)
13. TIA/EIA-526-14A (August 1998) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14
14. TIA/EIA-568-B.1 (2004) Commercial Building Telecommunications Wiring Standard
15. TIA/EIA-568-B.2 (2003) Commercial Building Telecommunications Wiring Standard

16. TIA/EIA-568-B.3 (2002) Optical Fiber Cabling Components Standard (ANSI/TIA/EIA-568-B.3-2000)
17. TIA/EIA-569-A (1998) Commercial Building Standard for Telecommunications Pathways and Spaces (ANSI/TIA/EIA-569-A-98)
18. TIA/EIA-569-A-2 (2000) Commercial Building Standard for Telecommunications Pathways and Spaces, Addendum 2 (ANSI/TIA/EIA-569-A-2-2000). This addendum defines the furniture pathways and spaces contained in work areas.
19. TIA/EIA-606-A (2002) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
20. ANSI/J-STD-607-A (2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
21. TIA/EIA – 758 (April 1999) Customer-Owned Outside Plant Telecommunications Cabling Standard
22. UNDERWRITERS LABORATORIES INC. (UL)
23. UL 444 (1994; R 1995, Bul. 1995 and 1996) Communications Cables
24. UL 467 (1993; Bul. 1994 and 1996, R 1996) Grounding and Bonding Equipment
25. UL 497 (1995) Safety Protector for Paired Conductor Communication Circuit
26. UL 514C (1988; R 1989, Bul. 1993 and 1994) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
27. UL 910 (1995; R 1995, Bul. 1995 and 1996) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
28. UL 969 (1995) Marking and Labeling Systems
29. UL 1286 (1993) Office Furnishings
30. UL 1581 (1991; Bul. 1993, 1994, 1995, and 1996, R 1996) Electrical Wires, Cables, and Flexible Cords
31. UL 1666 (1991; Bul. 1995 and 1996) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts
32. UL 1863(1995) Communication Circuit Accessories

E. Federal, state, local codes, rules, regulations, and ordinances governing the work shall be incorporated as part of these Technical Specifications.

F. In reviewing the various Contract Documents, the Design-builder shall be responsible for resolving conflicts between proposed design/concepts and the applicable standards, guidelines and practices.

3.2 EXAMINATION

A. Examine pathway elements intended for cables.

1. Verify proposed routes of pathways. Check raceways, cable trays, J-Hooks, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
2. Identify plan to support cables in suspended and/or open ceilings from the cable tray, conduits sizes and/or J-Hooks to the workstation locations. Verify that load capacity of cable support structures is adequate for each pathway.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 APPLICATION OF MEDIA

A. Horizontal Copper Cable for Data Service: Use UTP Category 6 cable (blue) for wiring runs between BDF or IDF's to workstations, cameras, lighting control, card access, energy management system or any other outlet identified as Data.

B. Horizontal Copper Cable for Voice Service: Use UTP Category 6 cable (white) for wiring runs between BDF or IDF's to workstation outlets.

3.4 TELEPHONE SYSTEM INSTALLATION DETAILS

A. Telephone System Patch Panels (110 blocks):

1. Provide Telephone system 110 wiring blocks with patch management in the BDF Room. Securely fix each panel to the telephone system backboard.

2. Provide a sufficient number of Telephone Patch Panels in Data System Equipment Rack to house all Telephone system information outlet connectors.

B. Telephone System Distribution Cables and Connectors:

1. Provide telephone distribution cable(s) running from each telephone outlet to the BDF and/or IDF on that floor. Provide telephone system distribution cable(s) at each combined telephone/data and/or telephone only outlet location.

2. Terminate each telephone system distribution cable(s) with an information outlet connector (MGS400-270) at the outlet end and on patch panel in the BDF or IDF end of the cable. Use the EIA/TIA-T568B wiring configuration, as defined in the ANSI/EIA/TIA-568-A-1995 Commercial Building Telecommunications Cabling Standard as detailed below:

Patch Panel	Conductor Color	Connector Pin
Pair 1	White/Blue	Pin 5
	Blue/White	Pin 4
Pair 2	White/Orange	Pin 1
	Orange/White	Pin 2
Pair 3	White/Green	Pin 3
	Green/White	Pin 6
Pair 4	White/Brown	Pin 8
	Brown/White	Pin 7

C. Telephone System Cross-Connects:

1. All Telephone System Cross-Connects will be completed by the University. Coordinate installation needs with University Representative in a timely manner as to not create a scheduling problem.

D. Telephone and/or Data System Faceplates:

1. Provide one (1) 6 Port Faceplate at each combination telephone/data and/or telephone only and/or data only outlet location. Fix each faceplate to the electrical back box with its full complement of screws.
2. Fix data and telephone connectors in the openings of the faceplate. Locate a blanking plate(s) in all unused openings in each faceplate.
3. Provide one (1) single Port Stainless Steel Faceplate (Wall +42" AFF) at each telephone only outlet.

3.5 DATA SYSTEM INSTALLATION DETAILS

A. Data System Patch Panels:

1. Provide Data System Patch Panels in the equipment racks located in the BDF and each IDF Telecom Room.
2. Provide a sufficient number of Data Patch Panels to house all Data system information outlet connectors.
3. Provide one 2U horizontal cable manager above and below each patch panel and power strip to allow for the horizontal routing of cables.

B. Data System Distribution Cables and Connectors:

1. Provide horizontal data system distribution cable(s) running from each data outlet to the BDF and/or IDF Telecom Room data system patch panel on that floor. Provide data system distribution cable(s) at each combined telephone/data and/or data only outlet location shown on drawings.
2. Terminate each data system distribution cable with an information outlet connector (MSG400-003) at outlet end of the cable. Use the EIA/TIA-T568B wiring configuration, as defined in the ANSI EIA/TIA cabling standard for premises horizontal wiring, shown below:

Patch Panel	Conductor Color	Connector Pin
Pair 1	White/Blue	Pin 5
	Blue/White	Pin 4
Pair 2	White/Orange	Pin 1
	Orange/White	Pin 2
Pair 3	White/Green	Pin 3
	Green/White	Pin 6
Pair 4	White/Brown	Pin 8
	Brown/White	Pin 7

3. Install station cables using the most direct route possible between outlet and patch panel while using the conduit, J-hooks and/or cable tray. Avoid distribution cables that are in excess of 250 feet in length.

C. Telephone and/or Data System Faceplates:

1. Provide one (1) 6 Port Faceplate at each combination telephone/data and/or telephone only and/or data only outlet location. Fix each faceplate to the electrical back box with its full complement of screws.
2. Fix data and telephone connectors in the openings of the faceplate. Locate a blanking plate(s) in all unused openings in each faceplate.

3.6 INSTALLATION PRACTICE

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceway and using conduit, J-Hooks and/or cable tray except within consoles, cabinets, desks, and counters and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

C. Cable Installation:

1. Install cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
2. Make terminations only at indicated outlets, terminals, and cross-connect and/or patch panels.
3. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
4. Secure and support cables at intervals 36" to 48" and not more than 6" from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install UTP cables using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

D. Wiring within Wiring Closets and Enclosures:

1. Use cable strain relief brackets behind all patch panels to prevent straining connections to prevent bending cables to smaller radii than minimums recommended by manufacturer.

E. Separation from EMI Sources: Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:

1. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:

a. Electrical Equipment Rating Less Than 2 kVA: 5 inches.
b. Electrical Equipment Rating between 2 and 5 kVA: 12 inches.
c. Electrical Equipment Rating More Than 5 kVA: 24 inches.

2. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: 12 inches.

3. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: 6 inches.

4. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches.
5. Fluorescent Fixtures: 5 inches.

F. Do not untwist more than 1/4 inch of Category 6 cables at connector terminations

G. Provide grommets and strain-relief for cables terminating on wall-mounted user outlets to ensure durable and robust connections. Leave a 4" slack loop in each cable neatly coiled in the backbox at each termination point.

H. Take due account of the minimum bend radius of all cables installed. No cables shall be installed in a fashion that contravenes the minimum bend radius of the cable.

I. Provide all cables in straight parallel runs when on cable trays and/or J-hooks. Hold cables running in the vertical direction in place with broad cable ties at not more than 15" centers. Hold cables running in the horizontal direction in place with broad cable ties at no more than 32" centers.

J. Telephone and data system cables shall run in dedicated cable tray, J-hooks and/or conduit provided for data and telephone system use only. Do not tie communication system cables to power or other foreign services. All cabling shall run parallel or at right angles to building wall structures.

K. Reinstate all pull-wires in conduits after use to facilitate future addition of cables.

L. Provide and install firestopping in accordance with all local and NFPA regulations to sustain ratings when passing through (floors, wall or ceilings) with; conduits, sleeves, raceway, cable tray, wire basket cable tray through fire-rated elements.

M. Install all cables in complete runs from outlet or patch panel to patch panel. In-line joints, splices, distribution points, or other intermediate connections are not permitted.

N. The Design-builder shall individually and properly ground all voice termination frames, data system equipment racks, copper riser sheaths and cable runway with #6AWG green stranded wire to the TMGB or TGB using two-hole compression lugs on each end.

3.7 GROUNDING

A. Comply with the appropriate Division 26 Section for "Grounding and Bonding" and with TIA/EIA 607.

B. Grounding Points:

1. Locate grounding busbars (MTGB) in BDF and (TGB) in each IDF Telecom Rooms.
2. Provide a ground connection from all voice termination frames, data system equipment racks, copper riser sheaths and cable runways to the grounding terminals in the MDF/BDF and IDFs.

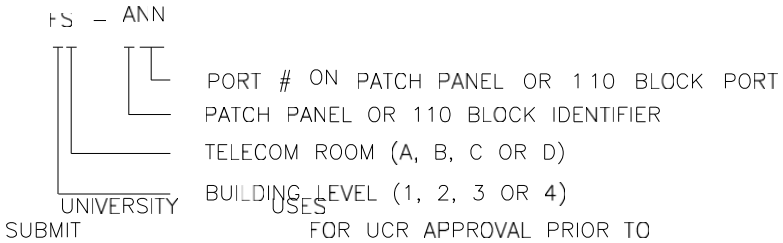
3.8 LABELING AND NUMBERING CONVENTIONS

A. General.

1. Outlets, cables, and terminations shall be labeled with a standard identification tag. Tags shall be typewritten or stamped with indelible waterproof ink and mechanically secured in a permanent fashion. Handwritten labels are NOT acceptable. Labels shall be mounted in a manner, which permits easy access and viewing. Receptacles, cables, and terminations shall be identified using the following conventions.

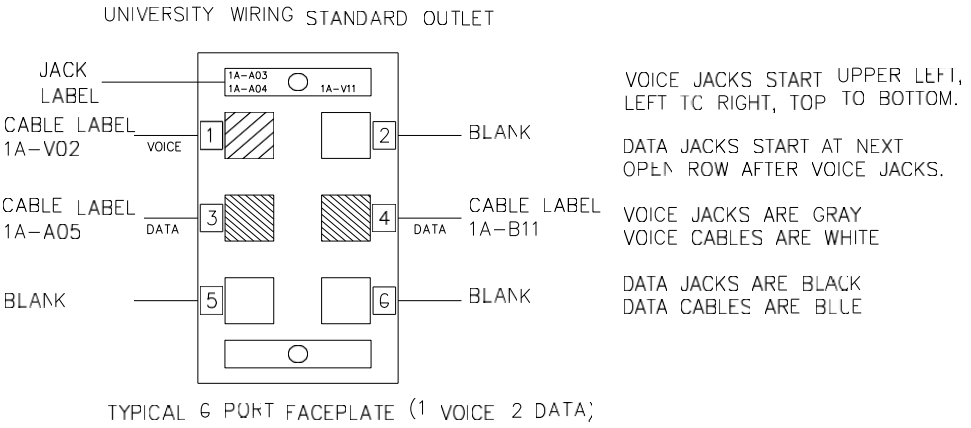
B. Station Cable:

1. Label each component of the telephone and data systems with its unique identification number using TIA/EIA 606-A Class 3 standards. The labeling and numbering scheme shall be compatible with the labeling and numbering scheme currently used by the University of California, Riverside. The labeling and numbering scheme used by the Design-builder shall be approved by the University Representative.
2. All labeling will follow the TIA 606-A Class 3 standard. Each telecommunications room; e.g. BDF or IDF will have a letter (A, B, C, etc.) assigned on each floor.
3. A workstation outlet and associated cabling identifier, unique within the building, shall be assigned to each workstation outlet and to its elements. A work station outlet shall have the form *fs-ann* where, *f* = BDF or IDF serving floor (B, 1, 2, 3, etc) and *s* = the BDF or IDF number (A, B, C, etc) and *a* = one or two alpha characters identifying the 48 port data system patch panel in the equipment rack or 110 termination block on the wall (A, B, C, D, etc) and *nn* = the port number on the patch panel or 110 termination block on the wall (01, 02, 03, 04, 05, etc). **DO NOT DUPLICATE PATCH PANEL OR 110 BLOCK IDENTIFIER**. . Voice jacks shall start at the top left position on the wall plate left to right top to bottom. Data jacks shall start at the next open lower row after all voice jack locations are populated. The voice jacks shall be gray and the data jacks shall be black. Data cables are blue and voice cables are white.



THE (UCR) TIA 606-A CLASS 3 STANDARD.
LABELING SCHEME
STARTING WORK.

C. Typical 6-Port Faceplate (1 Voice, 2 Data)



1. The cable serving each receptacle must be labeled at the receptacle and patch panel or 110 wiring block with wrap-around label. Label each cable (voice or data) so that the label is within 2" of the end of the cable at the 48 port data system patch panel end or 110 wiring block and at each outlet end.

D. Connectors:

1. Label each connector at each outlet (faceplate) location. The label shall be clearly visible for inspection.

E. Telephone System Termination 110 Block:

1. Termination 110 Block Labels. Provide a full complement of pre-printed cardboard patch frame labels, allowing each pair of each telephone system distribution, feeder, and external cable to be clearly identified. Telephone feeder cable pairs at terminal frames shall identify telephone outlet that they are connected to via the telephone station cable.

F. Data System Patch Panels:

1. Provide a full complement of data system patch panel labels, allowing each data system distribution and feeder cable connector to be clearly identified. Both copper and fiber connectors shall be labeled.

3.9 IDENTIFICATION

A. Cabling Administration Drawings: Show building floor plans with cable administration-point labeling. Identify labeling convention and show labels for telecom rooms, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings.

3.10 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

B. Category 6 UTP Cabling Tests:

1. Tests shall include all tests of Category 6, conducted from 1 to 250 MHz
2. Channel and permanent link tests shall be performed with a tester that complies with performance requirements in TIA/EIA-568-B.2, Level III. Include tests for longitudinal or transverse conversion loss.
3. Performance shall comply with minimum criteria in TIA/EIA-568-B.1 & B.2.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

3.11 TESTING AND DOCUMENTATION

A. General:

1. Acceptance testing shall be in compliance with TIA/EIA-568-B.1, B.2 & B.3.
2. A University Representative, at the option of the University, shall be present during testing.
3. Such acceptance testing shall in no way reduce the Design-builders' obligations regarding restoration, clean up, or warranty.
4. Design-builder shall be responsible for performing, tracking, and recording the results of tests.

B. Horizontal Station Cables:

1. Visual inspection will be made to insure that all cables have been terminated on the punch down block and on the eight-position station jack in proper color code order.
2. Four-pair station cables attached between station voice jacks and floor equipment room punch down blocks will be link tested with a cable analyzer to insure compliance with current EIA/TIA cabling standard Category 6 parameters. Four-pair station cables attached between data station jacks and floor equipment room jackfields will be link tested with a cable analyzer to insure compliance with current EIA/TIA cabling standard Category 6 parameters. All pairs shall test good and meet Category 6 parameters.
3. Test 100% of station wire in both directions with a certified Category 6 handheld tester, such as the OmniScanner 2 or Agilent Wirescope 350 or other Level III tester, and other test equipment as necessary to assure proper termination sequences, continuity, and Category 6 compliance. Station cables shall have NO bad pairs.
4. Test results shall meet or exceed the Category 6 test requirements as specified in the EIA/TIA cabling standard for premises horizontal wiring specifications. The approved Category 6 handheld tester will have the capability to be programmed with current Category 6 requirements as specified in the EIA/TIA cabling standard for premises horizontal wiring.

5. Documentation will include cable ID (same as jack ID) to be marked on the punch down block in the communication closet, station jack ID to be marked on the station jack, and results of Category 6 channel testing done with the cable analyzer. Analyzer documentation of testing shall consist of test result recorded in a ".txt" or ".csv" file on CD and on hard copy installed in a ring binder.

C. Test Equipment:

1. It will be the Design-builder's responsibility to provide the test equipment necessary and document to the University Representative the test equipment available for testing and the last date of certification.

2. Testing Equipment:

a. Continuity tester.
b. Power meter/source.
c. Equipment for two testers to communicate.
d. OmniScanner 2 or Agilent Wirescope 350 or other equal Level III tester.

D. Documentation:

1. The Design-builder shall submit three (3) copies (drawings hard copy 24" x 36" and Compact Disc) of the following as-built record drawings and documentation in a 3-ring binder following completion of testing (and re-certification, as necessary):

a. Construction Drawings: The as-built documentation shall be in AutoCAD min R2004 dwg or dxf equal and shall consist of the construction drawings with the station location numbers (faceplate identification numbers, e.g. 1A-V12, 1A-C15, etc.) inserted next to the symbol for each location.
b. Cat-6 Test reports to be provided in pdf file format and shall include and be arranged in:

1. Overall Summary Page (numerical order)
2. Telecom Room (BDF/IDF), Patch Panel (A thru Z) (numerical order)

END OF SECTION 27 1500

SECTION 27 5126 – ASSISTIVE LISTENING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Assistive Listening equipment coordination and installation.
2. Assistive Listening installation requirements.

1.2 DEFINITIONS

A. ALS: Assistive Listening system.

1.3 SUBMITTALS

A. Product Data: Stationary RF System and accessories.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of equipment in AV rack.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Listen Technologies
2. Or equal

2.2 TRANSMITTER AND ACCESSORIES

1. Listen Technologies LT-800-072 Base Transmitter (Qty: 1 ea.)

2. Listen Technologies LA-326 Rack mount kit (Qty: 1 ea.)

3. Listen Technologies LA-122 Universal antenna. (Qty: 1 ea.)

4. Listen Technologies LR-4200-072 Intelligent DSP RF Receiver (72 MHz) receiver (Qty: 4 each)

5. Listen Technologies LA-401 Universal Ear Speaker (Qty: 4 ea)

6. Listen Technologies LA-430 Intelligent Earphone/Neck Loop Lanyard. (Qty: 2 ea.)

7. Listen Technologies LPT-A107-B Dual RCA to Dual RCA Cable 6.6 ft. (Qty: 1 ea.)

8. Listen Technologies LA-381-01 Intelligent 12-Unit Charging Tray (Qty: 1 ea.)

9. Listen Technologies LA-304 ADA Access/Compliance signage kit. (Qty: 1 ea.)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ASSISTIVE LISTENING SYSTEM

A. Install an RF wireless assistive listening system for use by the hearing-impaired. The assistive listening system (ALS) shall be capable of broadcasting on 57 channels and be frequency agile. The RF receiver shall be capable of receiving on 57 wide and narrow band channels. The device shall tune to a single channel and user shall not be able to change the channel. The receiver shall have a signal-to-noise ratio of 80 dB or greater and shall have an audio frequency response of 50 Hz - 15 kHz (±3 dB). The device shall employ a unique DSP SQ™ noise reduction technology. The unit shall have a programmable squelch circuit. The unit shall incorporate a multi-functional display that indicates battery status, inventory number and channel. The device shall have the option of being lanyard or belt clip worn and the lanyard shall have the option of an integrated DSP driven neck loop that automatically senses and sends optimized audio signals directly to hearing aids and cochlear implants equipped with telecoils. The neck loop shall have a field strength of 400 mA/m (+/- 3dB) and frequency response of 100Hz to 5kHz (+/- 3 dB ref 1kHz). The device shall have a USB connector used for inventory control, set up, charging and firmware upgrades. The device shall incorporate automatic battery charging circuitry and use a non-proprietary lithium ion battery. The device shall have additional charging contacts to allow multiply charging options. The ALS system shall have 80dB SNR or greater, end-to-end. Listen Technologies Corporation products are specified.

B. The minimum number of receivers to be provided shall be equal to 4% of the total number of seats, but in no case less than two. 25% minimum of receivers provided, but no fewer than two, shall be hearing aid compatible in accordance with CBC Section 11B-706.3.

END OF SECTION 27 51 26

SECTION 28 1300 – ACCESS CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. The controller shall be Hirsch MX8 and MX2.

a. The controller shall be a fully stand-alone processor capable of making all access control decisions without the involvement of the server computer based on a set of parameters passed to the controller from the server.

4. The identification and location for security access is related to the building design and building type. In general, floors of a laboratory building shall be isolated. Building public entrances and service entrances shall be isolated. Close coordination with curtain wall systems, adjacent materials, hardware, parking, adequate lighting, and recessed telephone boxes with a nearby phone book for visitor night access shall be considered for each Project.
5. The system shall monitor door contacts for door propped alarms to sound at the readers.
6. The central control panel shall have an Ethernet network 10 base T card to allow connection to the campus network. Security system wiring shall be segregated from other systems. The central control panel shall be located in the MDF telephone room and include a hinged, lockable cover.

1.2 MANUFACTURERS

A. Acceptable Access Control System Manufacturers:
1. Hirsch

B. Products:

1. MX8 and MX2, controller and enclosure.
2. REB8, relay panel.
3. DTLM3, digital line module.

1.3 SYSTEM DESCRIPTION AND FUNCTION

A. Design and install an access control system including necessary hardware and software to perform the functions intended.

B. The system shall be fully integrated to the existing campus Hirsch access system and the existing hardware and software shall be modified to include the extended system.

C. The system shall provide the following functions:

1. Provide access control using the Weigand type access card.
2. Monitor access doors and other points for alarm and status.
3. Log selected events to the host system printer.
4. Upload access data to the host system terminal.
5. Display alarms on the host system terminal including a location plan.
6. Local programming of the system using a portable computer.
7. Access control decisions shall be made locally by the ACS automatically without the need for any operator intervention. Whenever an alarm or other exceptional situation occurs, the ACS shall automatically alert the existing campus central station operator via an Ethernet connection while simultaneously alerting any remote alarm terminal printer, executing preprogrammed output commands as established by the University's Representative. The systems or devices shall produce an orchestrated response to the event
8. The ACS shall provide programmed access control by card number time zones, and location of access. The existing campus central station shall be able to perform supervisory checks of ACS entry transactions.
9. The ACS shall perform data acquisition of facility security conditions and shall be capable of uploading transactions and/or events to the existing campus central station system and include the date, time, location, and nature of the event.
10. The ACS shall utilize distributed control architecture to ensure minimum upsets or shutdowns in the event of a single or multiple component failure. The ACS shall be capable of identifying the failed component(s) and bring it to the attention of the existing campus central station operator

1.4 SUBMITTALS

A. Submit complete coordination system documentation including, but not limited to:

1. Equipment location and conduit routing drawings.
2. Point-to-point wiring diagrams.

3. Descriptive literature and specification sheets for hardware and equipment.
4. Operating and maintenance instructions on hardware and equipment.
5. I/O (input/output device) point assignments.
6. Complete schedule and legend listing sensors, readers, etc., indicating its location, make and model number, I/O assignment, etc. Room numbers shall be actual, final building room numbers.
7. Database and software modification documentation indicating sequences of operation, listing of control program additions, flow charts of control program additions, and proposed floor maps with symbols to be programmed into the existing campus central station terminal.
8. Procedures and documents to be used for training, check-out, and commissioning (prior University approval required).

1.5 QUALITY ASSURANCE DURING CONSTRUCTION

A. The installation contractor shall have an established engineering, sales, installation, and service presence within Southern California. This office shall have been in operation for a period of not less than five years prior to the bid date of the project.

B. The Installation Contractor shall be a Branch office, a Main Office, or an authorized dealer and/or Installer of the system manufacturer and shall have done at least two (2) projects similar to this project in size and type in the last three (3) years.

C. The Installation Contractor shall be responsible for the complete installation and proper operation of the ACS, including the initial data input, system debugging, and initial calibration of system components.

D. A full-time Project Manager with a minimum of five (5) years experience with facilities of this size project and complexity shall be assigned to manage both the engineering/design and system installation/start-up phases of the projects. Close coordination and approval from and with the Design Professional is required.

1.6 SEQUENCE OF OPERATION

A. Operation of a valid card on an access control reader shall release the lock mechanism for a preset time.

B. Request to exit as detected by the motion sensor shall release the lock mechanism for a preset time.

C. While the lock mechanism is released, the alarm contacts shall be shunted to prevent an alarm.

D. If the alarm contacts are opened or are not closed at the end of the lock release preset time, a local alarm shall sound. This alarm shall be repeated to the control security station.

E. Card readers in elevator cars shall be linked to elevator controls to allow travel to selected floors. The system shall be capable of restricting access to floors not permitted by the access card.

PART 2 PRODUCTS

2.1 COMPONENTS

A. The access control system shall comprise the following principal hardware.

1. Intelligent Terminal Controller to support the Smart Terminal Interface Programming Equipment and communications with the existing central controller. Controller shall have a battery sized to provide six hours of power in event of primary power failure.
2. Smart Terminal Interface units for connection of door hardware and access reader.
3. Card Readers shall use the Weigand stripe technology as used on the campus. Card readers shall be suitable for their installed locations.
4. Access cards shall be Weigand "effect" security cards as used on the campus. Access cards shall be provided with the system preprogrammed with the University's facility code.
5. Door hardware shall consist of:

    a. Electric strikes as furnished in door hardware Division. Verify the strikes' power and connection requirements and provide equipment necessary to interface with the electric strike. Coordinate and provide necessary hardware for connection to any automatic disabled access control doors.
    b. Request to exit shall consist of a motion sensor mounted above the door.
    c. Door alarm contacts shall be coordinated with the door construction.
    d. Door alarm sounder shall be provided by each access control door to signal an alarm condition at that door.
    e. Where an access control door is installed on a means of escape, an emergency pull station shall be provided. The pull station shall release the door lock and signal an intrusion.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide conduit and wire from dedicated 120 VAC emergency power circuits.

B. Power supply wiring (120 VAC) shall be run in dedicated conduit. Power conduit shall be separated from control and signal conduits by a minimum of 3 inches.

C. ACS equipment shall be located such that it is accessible for service while maintaining clearances or walkways required around other equipment or obstacles.

D. Control elements located in outdoor installations shall be weatherproof.

E. Splices in shielded cables shall not be permitted. Terminations of shields and conductors shall be done in accordance with the manufacturer's instructions.

F. Cabling and wiring within panels shall be harnessed with tie wraps and secured in a neat and orderly fashion.

G. Cable runs shall be kept as short as possible, allowing extra length for making connections to termination points.

H. Each cable or individual conductor shall be labeled with a unique tag for quick identification during checkout, testing, and troubleshooting. Each component shall be permanently labeled with the device name and at each terminal point per Division 26 Section "Identification for Electrical Systems."

3.2 SYSTEM TESTING AND CHECKOUT

A. Prior to the acceptance test, the perform the following tasks:

1. Check for electrical continuity, eliminating shorts and open circuits, and verify grounding.
2. Install, calibrate, adjust, debug and set system's initial operating parameters including the existing campus central station.
3. Check out systems to verify the provided engineering documentation and approved submittals have been followed.

B. The ACS, including the interface with and programmed responses of the existing campus central station, must operate continuously for seven (7) days with no operational malfunctions or problems before setting an acceptance test date. Simulate different access and egress scenarios for worst case condition and simulate other alarm conditions to test the ACS's response and handling of situations. Keep a detailed log of tests conducted, problems encountered, and the corrective action that was taken.

C. Prepare and submit an Acceptance Test Plan for approval. This test shall include verification of communications, control, and response from the existing campus central station to a floor terminal controller, to a smart terminal interface, and finally to the sensor and controlled device to demonstrate the proper operation of control loops, conditional control and default sequences in accordance with the project documentation.

D. Obtain the approval of the University's Representative as to when the acceptance test will be performed.

E. Conduct the acceptance test in the presence of the University's security supervisor and/or of their designated Representative, following the approved Acceptance Test Plan.

F. The University's Representative shall check off and initial each successfully tested item. Demonstrate that the electromechanical systems are operating properly, and that the system is providing the required control sequences, alarms, graphic displays, and report generations.

G. An ongoing punch list shall be maintained throughout the test of items. This list shall contain items that must be corrected prior to accepting the system for beneficial use and commencement of the warranty period.

3.3 TRAINING

A. Furnish the services of competent instructor(s) who shall give a maximum of four hours instruction and orientation to the University's designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment, the affected systems, and the software provided. The training shall be customized to reflect the actual system installed rather than being a general (canned) training course. Each instructor shall be thoroughly familiar with all aspects of the subject matter they are to teach.

END OF SECTION 28 1300

SECTION 28 2300 - IP VIDEO SURVEILLANCE SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide a complete IP video recording system, including network video recorder, cameras, all components required for a fully functioning system, installation and commissioning.

1.2 RELATED SECTIONS

A. Section 270528 – Pathways for Communications.

B. Section 271500 – Communications Horizontal Cabling.

C. Section 282200 – Access Control System.

1.3 REFERENCES

A. Reference Standards: Provide systems which meet or exceed the requirements of the following publications and organizations as applicable to the Work of this Section:

1. Canadian ICES-003
2. Consultative Committee for International Radio (CCIR)
3. Conformity for Europe (CE)
4. Electronic Industry Association (EIA)
5. Federal Communications Commission (FCC)
6. Joint Photographic Experts Group (JPEG)
7. National Television Systems Committee (NTSC)
8. Phase Alternating by Line (PAL)
9. Underwriters Laboratories Inc. (UL)
10. Institute for Electrical and Electronics Engineers (IEEE)
11. Physical Security Interoperability Alliance (PSIA)
12. Open Network Video Interface Forum (ONVIF)

1.4 DEFINITIONS

A. HD (High-definition) – refers to video having resolution substantially higher than traditional television systems. HD has one or two million pixels per frame.

B. CIF (Common Intermediate Format) – refers to a standard video format, which is categorized based on the resolution.

1.5 SYSTEM DESCRIPTION

A. The Network Video Recorder (NVR) supports simultaneous recording, search, and system management for IP surveillance cameras. Multiple NVR's may be deployed for system expansion and multiple instances of client software run on the same workstation PC for simultaneous viewing of multiple units.

1.6 SUBMITTALS

A. Manufacturer's Product Data: Submit manufacturer's data sheets indicating systems and components proposed for use, including instruction manuals.

B. Shop Drawings: Submit complete shop drawings including connection diagrams for interfacing equipment, list of connected equipment, and locations for major equipment components.

C. Record Drawings: During construction maintain record drawings indicating location of equipment and wiring. Submit an electronic version of record drawings not later than Substantial Completion of the project.

D. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, customized to the system installed. Include system and operator manuals.

E. Field Tests: Submit results of field testing of every device including date, testing personnel, retesting date if applicable, and confirmation that every device passed field testing.

F. Maintenance Service Agreement: Submit a sample copy of the manufacturer's maintenance service agreement, including cost and services for a one year period for Owner's review. Maintenance shall include, but not be limited to; labor and materials to repair the system provide test and adjustments, and regular inspections.

1.7 QUALITY ASSURANCE

A. Manufacturer: Minimum ten years experience in manufacturing and maintaining IP video recording systems. Manufacturer shall provide toll-free technical assistance and support available 24/7.

B. Installer: Minimum two years experience installing similar systems, and certified by the manufacturer of the IP video recording system.

C. Environmental Conditions: The NVR shall be designed to function in the following environmental conditions:

1. Operating Temperature: 32°F to 95°F (0°C to 35°C).
2. Emissions: FCC part 15
3. Safety: UL 60950-1:2007; CSA C22.2 No. 60950-1.

D. Power Requirements: NVR shall have the following electrical specifications:

1. Input Voltage: 110/220 VAC 50/60 Hz
2. Operating Voltage: 110V/220V Auto Sensing
3. Dual hot plug, redundant power supply, 350 Watt

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's labeled packages. Store and handle in accordance with manufacturer's requirements, in a facility with environmental conditions within recommended limits.

1.9 WARRANTY

A. Manufacturer's Warranty: The warranty period shall be a minimum of twelve (12) months from the delivery date of the system under normal use and service.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. IP Video Recording System (NVR) Manufacturer:

2.2 SYSTEM COMPONENTS

A. IP CAMERAS

1. Sony SNC-EP550 (Exterior PTZ), Sony SNC-EM602RC (Exterior Fixed)
2. Sony SNC-EM601 (Interior)
3. Sony SNC-DH110W (Elevator)

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine site conditions prior to installation. Notify Architect and Owner in writing if unsuitable conditions are encountered. Do not start installation until site conditions are acceptable.

3.2 INSTALLATION

A. Test all components before shipping to the project location

B. NVR system shall be installed, programmed, and tested in accordance with manufacturer's installation instructions.

1. Coordinate interfaces with Owner's representative where appropriate.
2. Provide backboxes, racks, connectors, supports, conduit, cable, and wire for a complete and reliable installation. Obtain Owner's approval for exact location of all boxes, conduit, and wiring runs prior to installation.
3. Install conduit, cable, and wire parallel and square with building lines, including raised floors areas. Do not exceed forty percent fill in conduits. Gather wires and tie to create an orderly installation.
4. Coordinate with other trades to provide proper sequencing of installation.

3.3 FIELD COMMISSIONING AND CERTIFICATION

A. Field Commissioning: Testing the IP Video Recording system as recommended by manufacturer, including the following:

1. Conduct complete inspection and testing of equipment, including verification of operation with connected equipment.
2. Test devices and demonstrate operational features for Owner's representative and authorities having jurisdiction as applicable.

3. Correct deficiencies until satisfactory results are obtained.
4. Submit written copies of test results.

3.4 TRAINING

A. Conduct on-site system administrator and security/surveillance operator training, with the number of sessions and length of sessions as recommended by the NVR system manufacturer. Training shall include administration, provisioning, configuration, operation, and diagnostics.

END OF SECTION 28 2300

SECTION 28 3100 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Fire Alarm Control Unit.
2. Manual Fire Alarm Boxes.
3. Analog Sensors.
4. Conventional Detectors.
5. Miscellaneous Detection.
6. Addressable Modules.
7. Notification Appliances.
8. Magnetic Door Holders.
9. Remote Annunciators.
10. Addressable Interface Modules.
11. Digital Alarm Communicator Transmitter.
12. Network Printer.

B. Related Work in other Sections or Divisions:
Coordinate with work of all other trades as required, including but not limited to:

1. Electric door locks or gate controllers
2. Electric/magnetic door holders
3. Integral fire door smoke detectors and magnetic hold-opens
4. Water flow switches
5. Sprinkler valve supervisory switches
6. Mechanical HVAC, Damper controls & EMS
7. Raceways, boxes, outlets and terminal cabinets

1.2 DEFINITIONS

A. Definitions in NFPA 72 and UL 864 are inclusive to this section.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

D. FACP: Main Fire Alarm Control Panel.

E. MINIPLEX: Remote input/output panel connected to a FACP via Remote Unit Interface.

F. NETWORK: FACP(s) interlinked via dedicated fiber connections to the TSW.

G. IMS: Integrated Management System – Campus FACP Network Portal.

H. RPS: Remote Power Supply for conventional horns and strobes.

1.3 SYSTEM DESCRIPTION

A. This section of the specification includes the furnishing, installation, and connection of the microprocessor-controlled fire alarm equipment required to form a complete coordinated system ready for operation. Provide a complete and operable active multiplex, addressable fire alarm system for the protected premise building referred to as Multidisciplinary Research Building 1 (MRB1).

B. Base bid is to provide the protected premise fire alarm system, connected as part of the existing active-multiplex, fiber-optic cabled, Campus Remote Station Fire Alarm System.

C. The system shall comprise all necessary component parts to provide the functions and facilities described and obtain the required approvals.

1. Fire Alarm Control Panel (FACP)

2. Alarm initiating devices.

   a. Manual stations.
   b. Area photoelectric smoke detectors (Total coverage throughout occupiable spaces).
   c. Heat detectors - fixed and combination where environmental conditions merit.
   d. Wet pipe automatic fire sprinkler water flow and valve tamper switches.

3. Fire alarm terminal and power supply cabinets.

4. Remote control relays for air handling fans and dampers, elevator recall service, access control, supervision of emergency power systems, energy management systems, and similar auxiliary control devices and modules.

5. Alarm audio/visual notification appliances (horns and strobe lights) to meet NFPA 72 & ADA provisions.

6. Conduit, boxes, fittings, hangers, outlets, wiring, etc. required to provide power to and interconnect all components listed above within the building and identified points of connection to components in adjacent buildings, as required.

7. Conduit, 24 strand multi-mode fiber optic cable, patch cables, breakout boxes, multiplex panels, connections, fittings, terminations, etc. to connect the protected premise building fire alarm to the Campus fire alarm fiber optic infrastructure at the identified point of connection in the adjacent Material Science & Engineering (MS&E) building under provisions of the base bid.

8. Conduit, wiring, outlets, etc. required to provide power to and interconnect any devices supplied under other Divisions, including:

   a. Electric door locks or gate controls, release controls.
   b. Electric/magnetic door holders.
   c. Sprinkler water flow switches.
   d. Sprinkler valve supervisory switches.

e. Smoke / Fire dampers.
f. Energy management systems, HVAC shut down.
g. Emergency generator and power systems.
h. Integral fire door smoke detectors and magnetic hold-opens.

D. Copies of as-built drawings shall be provided as computer aided drafting (CAD) files, compatible with the AutoCAD (2010) or equal, *.dwg file format and *.dxf format. The content of the CAD files shall include only fire alarm system elements and contain no proprietary xref's, fonts or features.

1.4 WARRANTY

A. Equipment shall be manufactured by the indicated suppliers, or others as allowed by testing lab approvals or listings. All equipment shall be supplied and warranted by the system installer for no less than two years from date of completion of acceptance testing. Such warranty shall be required of the installing contractor, even if in excess of original manufacture warranties. Documentation to be provided as part of project close-out. Refer to specification section 01 7700 Closeout Procedures for requirements.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance FACP and raceways shall withstand the effects of earthquake motions determined according to the VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEM SPECIFICATION SECTION.

B. Special Provisions – System Operation Requirements:

1. Alarm Verification Operation

a. When an alarm condition is detected by a smoke sensor, on an Initiating Device Circuit or Signaling Line Circuit, which has been programmed for Alarm Verification, the system will automatically enter the ALARM verification mode of no greater than 30 seconds.

2. Signal Silence Operation

a. All Notification Appliance Circuits shall be programmed to silence off if the panel signal silence switch is manually activated. Visual devices shall continue to operate until the system is reset.

3. Building Evacuation Capability

a. The protected premise FACP and the existing Campus system receivers shall be programmed with a "general building evacuation" command button, matching existing Campus Standard.

1.6 SUBMITTALS

A. General Submittal Requirements:

1. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire alarm system design.
    b. Fire alarm certified by NICET, minimum Level II.

B. Product Data:

1. Provide manufactures data sheets and CSFM listing sheets for all products.

C. Shop Drawings:

1. Fire Alarm System:

    a. Include plans, elevations, sections, details, riser diagrams, general notes, location, Scope of the Work and attachments to other work, etc. required by local Authorities.
    b. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
    c. Contractor shall comply with recommendations in the “Documentation” Section of the “Fundamentals of Fire Alarm Systems” chapter in NFPA 72 by preparing and submit detailed shop drawings meeting the provisions of NFPA 72 and California Fire Code to the Office of the Campus Fire Marshal, and obtain approvals prior to proceeding with installation. The University Representative and Campus Fire Marshal approval of submittals and/or shop drawings is for permission to proceed with installation and does not authorize design, products, or installation not conforming to referenced codes and standards and this specification.

    d. Include voltage drop calculations for all notification appliance circuit.

        1) Worst case only calculations are not acceptable.

    e. Include battery-size calculation(s) with stand-by and alarm loads for all components.

    f. Include electrical panel and circuit number for all 120VAC sources.

    g. Drawings shall include identification of all terminals and illustrating all typical device wiring connections.

    h. Device Address:

        1) Show the address for each addressable device shown on the plans.
        2) Coordinate custom device label with DCFM prior to programming labels.

    i. System Riser Diagram: Show all equipment, terminal cans, devices, conduit routing, cable routing and cable type and quantity. Provide ladder type riser lay-

out with all interconnecting conduits.

j. Wiring Diagrams: Provide wiring type, part number, manufacture and color code.

k. Power, Signal, and Control Wiring: Include diagrams for equipment and for system with all terminals and interconnections identified.

l. Ductwork Drawings: Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors on plans according to manufacturer's written recommendations.

m. Room numbers: Confirm room numbers being used in programming are the final numbers assigned by Facilities Management.

D. Submittals to Campus Fire Marshal (DCFM): In addition to distribution requirements for submittals specified in Division 01 Section "Submittals," make an identical submittal to the University. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit as required to make clarifications or revisions to obtain approval. On receipt of comments from Campus Fire Marshal, submit them to the University for review.

E. Resubmittals: Make corrections and resubmit drawings as required until the plans are reviewed and approved by the Campus Fire Marshal.

F. Delegated-Design Submittals: The Mechanical Engineer of Record will coordinate the specific location of each duct detector with the mechanical, electrical and fire alarm contractors prior to the installation of any duct mounted device.

G. As-built drawings shall be prepared and operation and maintenance manuals shall be prepared and provided for approval prior to requesting acceptance testing from the office of the Campus Fire Marshal. The installing contractor shall prepare required Certificate of Compliance per NFPA 72, prior to requesting acceptance testing from the office of the Campus Fire Marshal.

1. Copies of as-built drawings shall be provided as computer aided drafting (CAD) files, compatible with the AutoCAD (2010) or equal, *.dwg file format and *.dxf format. The content of the CAD files shall include only fire alarm system elements and contain no proprietary xref's, fonts or features.

1.7 QUALITY ASSURANCE

A. The system of this project shall be classified as a protective premise (local) fire alarm system and shall also be a component of the Campus proprietary supervising station fire alarm system, as defined by NFPA 72, 2013 Edition with State amendments.

B. All equipment shall be currently listed by Underwriters' Laboratories, FM, ETL, or equivalent and the California State Fire Marshal.

C. All systems shall be designed, installed, and perform in accordance with appropriate statutory codes and referenced standards. Editions or versions of such codes and/or standards shall be as accepted as those legally adopted by the Building Standards Commission, enforced by the Office of the State Fire Marshal (OSFM), in effect at the time the plans for the proposed project were approved by the Regents of the University of California and preliminary plans were submitted to the Office of the Campus Fire Marshal. The contractor, subcontractor, supplier, designer, technician, and any other involved parties shall also perform their respective scope of work in conformance with acceptable industry practices.

D. Installing Contractor, and any second or third tier sub-contractor shall demonstrate satisfactory installations of comparable systems within the immediately preceding five years, including references.

E. Installing Contractor, and any second or third tier sub-contractor shall demonstrate ability to provide response to effect repair within 4 hours by factory certified personnel, during the warranty period.

F. Installer Qualifications:

1. Personnel installing wire, cable, devices or making final connections shall be trained or supervised by the manufacturer.

2. Installers shall be licensed, as required, by the State of California.
   a. Electrical Components, Devices, and Accessories:
      1) Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to California State Fire Marshal, and marked for intended use.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by The University or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify University's Representative no fewer than fourteen calendar days in advance of proposed interruption of fire alarm service.

2. Do not proceed with interruption of fire alarm service without the University's Representative written permission.

1.9 SOFTWARE SERVICE AGREEMENT

A. End-User Technical Support: The campus is trained on all software required for the proper operation, programming, servicing or testing of the FACP and FACP Network. Additional Software and Hardware training for the Campus staff shall be coordinated with the Facilities Department on as needed bases.

B. At the completion of the project update the FACP software and firmware to the latest

version required for proper operation of the system. Provide access for software and firmware upgrades via the internet. Upgrade shall include new or revised licenses for use of the software.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quantities of the following devices equal to 10 percent of the amounts shown for each device on the approved plans but no less than one of each type of device.

a. Pull Station.
b. Addressable Monitor Module.
c. Addressable Control Module.
d. Smoke Detector Head (sensor).
e. Smoke Detector Base.
f. Heat Detector Head (sensor).
g. Heat Detector Base.
h. Duct Detector Housing with Head.
i. In-Duct Detector Housing.
j. Indoor Indicating Devices: Horn, Speaker, Strobe and/or combination devices.
k. Keys and Tools: One set of each key and/or special tool used for locks and access.

PART 2 - PRODUCTS

2.1 MULTIPLEX TYPE SYSTEM

A. University requires a protected premises system; an addressable multiplex microprocessor-controlled Fire Alarm System. Systems that do not meet the following criteria shall not be considered:

1. The system shall be fully programmable by Campus personnel or system supplier using equipment provided as part of this project.

2. All memories shall be maintained during loss of all power supplies, (including batteries), and the system shall automatically restore to its normal operating mode upon restoration of power.

3. The system shall be provided with electric horns, strobes, and/or combination horn/strobes as required to achieve current ADA provisions for the building.

4. Remote data gathering panels, if used shall be capable of operating all critical functions required for safe evacuation while disconnected from the main processing unit due to communications link or main processor derangement.

2.2 FIRE ALARM CONTROL PANEL (FACP)

1. The system control panel shall be a Simplex Model 4100ES and shall be configured with all

required components, modules, etc. to provide for the complete operation of the system. The system shall also be provided with and configured to support (2) 250 point IDNET circuits. Also, support 2 remote annunciator's locations/enclosures.

Additionally, the system shall be provided with no less than 16 programmable form "C", dry relay outputs within the building to be used as described herein. Such contacts shall be pre-wired by the installing contractor using a style D, IDC, for each contact to a dedicated surface mounted junction box, sized per CEC, Article 370 for 1.5 times the number of conductors required. Such junction box shall be located within 3 feet of the control panel and no greater than 5 feet above finished floor. Fire alarm control panel cabinet shall be surface mounted, red in color. The control panel cabinet shall contain required space for all components involved and shall be sized for required expansion to include spare capacities as indicated within this specification or construction drawings.

2. The system shall communicate with the existing Campus receiver system fiber-optic loop using all required interface components, hardware, and software, to be contractor provided and installed. Contractor shall be responsible for confirming mode of communication and routing, prior to system shop drawing submittal preparation.

3. System Capacity and General Operation

   a. The control panel shall be capable of expansion as specified above.

   b. The CPU shall provide the following controls and indicators used by the system operator:

AC POWER	(Green LED)
SYSTEMS ALARM	(Red LED)
SUPERVISORY	(Yellow LED)
SYSTEM TROUBLE	(Yellow LED)
SIGNALS SILENCED	(Yellow LED)
POWER TROUBLE	(Yellow LED)
ACKNOWLEDGE	(Momentary Switch)
SIGNAL SILENCE	(Momentary Switch)
SYSTEM RESET	(Momentary Switch)
DISABLE/ENABLE	(Momentary Switch)
EVACUATION DRILL (Programmed F Key)	(Momentary Switch)
DAMPER BYPASS (Programmed F Key)	(Momentary Switch)
HVAC BYPASS (Programmed F Key)	(Momentary Switch)
ELEVATOR BYPASS (Programmed F Key)	(Momentary Switch)

   c. All programming shall be accomplished through manufactures\ listed instructions with all required computer hardware and software provided to the Owner as specified above.

   d. Entry into program mode, if requiring a special key and/or a special password, shall be provided to the Owner.

4. Central Processing Unit Module

   a. The central processing unit (CPU) module shall, and will communicate, monitor and

control all other modules in the panel. Removal, disconnection, failure, or change of type of any control panel module shall be detected and reported by the CPU as a module failure. The CPU shall contain and execute all custom programs for specific action to be taken if a fire situation is detected in the system. Programming shall be held in non-volatile memory, and shall not be lost even if system primary and secondary power failure occurs.

5. Enclosures:

   a. The control panel shall be housed in the manufacturer's UL-listed cabinet suitable for surface or semi-flush mounting. Provide NEMA 3R enclosure for all outdoor devices.

   b. The back box and door shall be constructed of .060 steel with provisions for electrical conduit connections into the sides and top.

   c. The door shall provide a key lock matching Campus standard and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door shall be selectable for either right or left-hand hinging.

6. Power Supply:

   a. The main power supply for the fire alarm control panel shall provide all control panel and peripheral initiating device power needs.

   b. All system power supplies shall meet UL 864 Standards and NFPA, and NEC requirements for power-limited operation on all SLC, IDC, and NAC circuits.

   c. Integral positive-temperature-coefficient thermistors, circuit breakers, and other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 100 AH, or may be used with external battery and charger systems. Battery arrangement may be configured in the field.

   d. The main power supply shall continuously monitor all field wires for Earth Ground conditions and shall have the following indications:

      1) Ground Fault
      2) Battery Fail
      3) AC Power Fail

   e. All power supplies shall be provided pigtails or otherwise configured to allow the safe addition, and use of a voltmeter and ammeter for diagnostic purposes.

B. Batteries

1. All FACP and NAC power supplies shall be provided with batteries, sized for sufficient capacity to power the fire alarm system for not less than 24-hours plus 5 minutes of alarm upon a normal AC power failure.

2. The batteries are to be completely maintenance free, gel cell technology. No fluid level checks,

refilling, spill potential or and leakage shall not be permitted.

3. In necessary to meet requirements, external battery and charger systems may be used.

C. Notification Appliances

1. Programmable Electronic Horns:

   a. System Sensor, SpectrAlert Advance series, HR or H12/24K as appropriate (no known equal).

   b. Electronic horns shall be field programmable without the use of special tools, to provide temporal (Uniform Fire Alarm Signal) slow whoop, or continuous tone with an output sound level of at least 88 dBA measured at 10 feet from the device. All devices shall be field pre-set for High Volume, unless noted otherwise, and subject to field adjustment at no additional charges.

   c. Shall be flush or surface mounted, wall or ceiling mounted.

2. Electric strobes:

   a. System Sensor, SpectrAlert Advance series, SR (no known equal) meeting the requirements of the ADA, UL Standard 1971 and be field pre-set for 75cd unless noted otherwise.

3. Horn Strobe Combination Devices:

   a. System Sensor, SpectrAlert Advance series, P2R (no known equal).

   b. Electronic horns shall be field programmable without the use of special tools, to provide temporal (Uniform Fire Alarm Signal) slow whoop, or continuous tone with an output sound level of at least 88 dBA measured at 10 feet from the device. All devices shall be field pre-set for High Volume, unless noted otherwise, and subject to field adjustment at no additional charges

4. NAC Appliances:

   a. Altronix model AL1002UL-ADA power supply, or equal of the same manufacture.

   b. The quantity of power supplies shall be based upon no less than four notification appliance circuits per floor or as necessary to maintain a maximum calculated point-to-point voltage drop of less than 10 percent, of the normal operating voltage of the circuit. Voltage drop is subject to field verification during acceptance testing. Power supply NAC circuits shall be individually monitored for two distinct trouble conditions, power supply and logic board by the fire alarm control panel.

5. The installing contractor is responsible for providing sufficient audible devices to meet the requirements of NFPA 72 for a system operating in the public mode and sufficient visible devices to comply with the provisions of NFPA 72 and ADAAG.

D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

1. Display shall be mounted so that the viewing window is located between 4’9” and 5’0” above finished floor.

2.3 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements and approval of the University’s Representative, provide products compatible with the existing Campus TSW and Network (Simplex Model 4100ES is the Campus Standard):

1. FACP Equipment and enclosures:

a. SimplexGrinnell.
b. WSA.
c. Hoffman (weatherproof applications only).

2. Wire and Cable:

a. Comtran Corporation.
b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
d. West Penn Wire/CDT; a division of Cable Design Technologies.

3. Audible and Visual Signals:

a. SimplexGrinnell.
b. Wheelock (weatherproof applications only).

2.4 ADDRESSABLE MANUAL FIRE ALARM BOXES

A. UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

B. Double action break-glass type. With integral addressable module, arranged to communicate individual manual-station status (normal, alarm, or trouble) to the FACP and Campus GCC. They shall use a key operated test-reset lock, matching Campus standard, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

1. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

2.5 ADDRESSABLE ANALOG SENSORS

A. Smoke Sensors:

1. Type: Smoke sensors shall be of the photoelectric.

    a. Simplex or equal and use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

    b. Bases: Relay output, Remote LED, sounder and isolator bases shall be supported alternatives to the standard base. The base shall be of a common type from the manufacturer so as to allow for either smoke or heat sensors to be installed, without replacement of the base.

2.6 HEAT SENSORS

A. Thermal Sensor:

1. Where deemed necessary, use of heat sensors shall be a combination rate of rise and fixed temperature type. The fixed temperature element shall be selected based upon maximum anticipated ceiling temperature. In locations where weatherproof devices are required, heat sensors shall be of rate compensation type. Heat detectors shall be Simplex or equal, intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit

2.7 ADDRESSABLE CIRCUIT INTERFACE MODULES

A. Addressable Dry Contact Monitor Module:

1. Addressable monitor modules shall be Simplex or equal and provided to connect typically one, or no more than two supervised IDC zone of conventional alarm initiating devices (example: waterflow and tamper, or NAC Power supply trouble) to one of the fire alarm control panel SLCs.

2. The monitor module shall mount in a 4-inch square (101.6 nun square), 2 1/8 inch (54 nun) deep electrical box.

3. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

2.8 VIVARIUM LEVEL ALARM NOTIFICATION APPLIANCES

A. Speakers: System Sensor SPC and SPCV

1. System Sensor, SpectrAlert Advance series, SPC and SPCV as appropriate producting an evacuation tone between 430 hz and 470 hz.

a. Field adjust sound pressure from 77 dB to 90 Db as required, to provide meased at 10 feet from the device (verify with AHJ for requirments therin). All devices shall be field pre-set for High Volume, unless noted otherwise, and subject to field adjustment at no additional charges. Speaker will provide ¼, ½, 1 and 2 watt tap option.

b. Enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.

c. Specialized notification appliances required in support of vivarium activities shall be allowed subject to electrical compatibility. Speakers shall be initially tapped at 1 Watt, field verification with Fire Marshal may require increase or decrease of SPL at each location.

2. Visible/Only:

a. System Sensor, SpectrAlert Advance series, SR (no known equal)

1) Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.

2) The wall mount V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. The ceiling mount V/O shall mount to a single gang electrical box.

3. Non-Vivarium Audible/ Visible:

a. System Sensor, SpectrAlert Advance series, P2R (no known equal).

1) Field programmable without the use of special tools, to provide temporal (Uniform Fire Alarm Signal) slow whoop, or continuous tone with an output sound level of at least 88 dBA @ 24VDC measured at 10 feet from the device.

2) The audible/ visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.

3) The appliance shall be capable of two-wire synchronization with one of the following options:

a) Strobes shall synchronize throughout the entire facility.

b) Synchronized Strobe firing to NAC sync signal with Horn silenced.

2.9 ADDRESSABLE ALARM NOTIFICATION APPLIANCES

1. Programmable Electronic Horn:

a. System Sensor, SpectrAlert Advance series, HR or H12/24K as appropriate (no known equal).

1) Field programmable without the use of special tools, to provide temporal (Uniform Fire Alarm Signal) slow whoop, or continuous tone with an output sound level of 88 dBA @ 24VDC measured at 10 feet from the device (excluding Vivarium/animal holding spaces. Verify with AHJ for requirements therein). All devices shall be field pre-set for High Volume, unless noted otherwise, and subject to field adjustment at no additional charges.

2) Enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.

3) Specialized notification appliances required in support of vivarium activities shall be allowed subject to electrical compatibility.

2. Visible/Only:

a. System Sensor, SpectrAlert Advance series, SR (no known equal)

1) Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.

2) The wall mount V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. The ceiling mount V/O shall mount to a single gang electrical box.

B. Notification Appliance Circuit (NAC) Power Extender:

1. Altronix model AL1002UL-ADA power supply, or equal of the same manufacture.

a. The quantity of power supplies shall be based upon no less than four notification appliance circuits per floor or as necessary to maintain a maximum calculated point-to-point voltage drop of less than 10 percent, of the normal operating voltage of the circuit. Voltage drop is subject to field verification during acceptance testing. Power supply NAC circuits shall be individually monitored for two distinct trouble conditions, power supply and logic board by the fire alarm control panel.

2. Notification appliance circuits shall be Class B Style 4. Unless noted elsewhere.

    a. Batteries are to be completely maintenance free, gel cell technology. No fluid level checks, refilling, spill potential or and leakage shall not be permitted.

3. The NAC extender panel may be mounted close to the host control panel or can be remotely located.

4. Provide sufficient audible devices to meet the requirements of NFPA 72 for a system operating in the public mode and sufficient visible devices to comply with the provisions of NFPA 72 and ADAAG.

2.10 ADDITIONAL SYSTEM COMPONENTS

A. Description:

1. Equipped for mounting as indicated and with screw terminals for system connections.

    a. Combination Devices:
    b. Factory-integrated audible and visible devices in a single-mounting assembly.

2. Sprinkler Bell:

    a. Electric-vibrating, 24-V dc, under-dome type; with provision for housing the operating mechanism behind the bell. Bells shall produce a sound-pressure level of 94 dBA, measured 10 feet from the bell. 10-inch size, unless otherwise indicated. Bells shall be provided with weatherproof back box where indicated.

3. Waterflow Switches:

    a. The fire sprinkler system shall be provided with vane type water flow switches as necessary to indicate only the floor with water flow occurring, per NFPA 13.

    b. Waterflow Switches shall have an alarm transmission delay time which is adjustable from 0 to 60 seconds (Initially set at 45 seconds). Any required time delays for water surge shall be provided by the water flow switch. No delays shall be used by the programming of the software of the fire alarm control panel, unless specifically approved in writing by the University.

    c. All waterflow switches shall come from a single manufacturer and series.

    d. Where possible, locate waterflow switches a minimum of one (1) foot from a fitting which changes the direction of the flow, a minimum of three (3) feet from a valve, and/or manufactures listed instructions.

    e. The University shall be provided three sets of any specialized tools used for normal access of the device.

4. Tamper Switches (Furnished by Fire Sprinkler Division)

a. Any above ground fire sprinkler control valves shall be provided with appropriate tamper switches that provide a distinct supervisory alarm at the control panel and off-site retransmission of the distinct supervisory alarm.

b. Each sprinkler system water supply control valve riser, zone control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.

c. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.

d. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4 inch (19 mm) weather tight conduit entrance, weather tight flex and incorporate the necessary fittings for attachment to the valves. The switch housing shall be finished in red baked enamel.

e. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting. The University shall be provided three sets of any specialized tools used for normal access of the device.

f. Valve supervisory switches shall be provided and connected under this section and installed by fire sprinkler contractor.

2.11 GUARDS FOR PHYSICAL PROTECTION

A. Description:

1. Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
2. Factory fabricated and furnished by manufacturer of the device.
3. Finish: Paint of color to match the protected device.

2.12 REMOTE INDICATORS

A. Remote status and test switches with LED indicating lights.

1. LED is connected to flash when the associated device is being polled by the FACP.
2. The LED and LED test switch are mounted on a plate and designed to flush mount to a single-gang electrical.

2.13 MAGNETIC DOOR HOLDERS AND CLOSERS

A. Description:

1. Units are equipped for wall or floor mounting and are complete with matching door plate.
2. Interfaced to the FACP to shut down on alarm.

3. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
4. Rating:

    a. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develops a minimum of 25 lbs. holding force.

    b. Door holders controlled by the fire alarm system shall not be powered from the fire alarm system. Door holders shall be de-energized through a buffer relay, by opening of a normally closed dry contact provided by the control panel and shall release automatically on power failure.

B. Material and Finish: Chrome or brushed aluminum unless noted otherwise.

C. Door holders are to be installed by the door hardware contractor.

D. Door Closers are to be supplied and installed by the door hardware contractor.

2.14 REMOTE ANNUNCIATOR

A. Description – Protected Premise:

1. Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing as allowed by the AHJ.

2. Remote annunciators shall be programmed to allow acknowledgement and review of alarm activity without the use any key or tool. All functions other than review shall require the switches be activated/enabled from an integral key switch, keyed to match Campus standard.

B. Display Type and Functional Performance:

1. Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2. Mounted on the unit shall be an audible signaling device, which shall be activated upon any alarm or trouble condition, and a buzzer silencing switch. Switch shall be automatically restoring type, after correction of alarm or trouble condition, such that any subsequent alarm or trouble will sound the buzzer. All components to be compatible with Fire Alarm Control Panel operation and U.L. listed.

C. Outdoor Enclosure for Remote Annunciator:

1. Type: Stainless Steele with hinged windowed door for viewing annunciator.
2. Manufactured from 16 or 14 gauge Type 304 or Type 316L stainless steel. Seams continuously welded and ground smooth. Minimum width body flange to provide maximum door opening. Door to include handle with key lock. Window door enclosures have a clear polycarbonate window mounted flush with door surface.

3. Mounting: Surface type. Panel mounting studs fit optional panels and other accessories. Mounting holes in back of body for direct mounting or for optional external mounting brackets.
4. Provide quarter turn handle with locking key.

D. Provide Sprinkler Bell and General Alarm Horn at an outdoor location approved by the DCFM.

2.15 NETWORK INTERFACE

A. Furnish and install network media hardware and software as required to match network left and right topographic network panels required for network left and right topographical neighbor and update camous Truesite. All events are to be reported to the Campus TSW for archiving and printing of events and event history as required by University's Representative.

2.16 WIRE, CABLE, AND FIBER

A. Wire and cable: All wiring shall be installed in metal conduit or fire rated MC cable, or within equipment. Conductors shall be installed in accord with Specification Section 16. Conductors within equipment enclosures shall be carefully cabled and laced. Minimum conductor size for NAC circuits shall be No. 14 AWG, 7 strand copper, THHN insulation, installed within metallic conduit. Sizing of wire shall be subject to a maximum voltage drop of 10 percent. Conductors for SLC shall be as specified by the control panel manufacture. Metallic conduit systems shall be no smaller than ¾" or sized as to not to exceed 40 percent fill per CEC. MC cable conductors must be labled.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Installation shall be in accordance with the state adopted codes, local provisions, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. Conduit: All conduit and its installation shall be in accordance with Specification Section 26. All fire alarm system conduits shall be externally identified at no greater than 20 ft. intervals, and at junction boxes by permanent red paint suitable for the purpose. Box cover shall be red in color. Exposed flexible conduit shall be liquid tight and shall not exceed 3 ft in length and shall transition properly into metallic conduit.

D. Wire and cable: All wiring shall be installed in metal conduit or fire rated MC cable, or within equipment. Conductors shall be installed in accord with Specification Section 26. Conductors within equipment enclosures shall be carefully cabled and laced. Minimum conductor size for NAC circuits shall be No. 14 AWG, 7 strand copper, THHN insulation, installed within metallic conduit. Sizing of wire shall be subject to a maximum voltage drop

of 10 percent. Conductors for SLC shall be as specified by the control panel manufacture. Metallic conduit systems shall be no smaller than ¾" or sized as to not to exceed 40 percent fill per CEC.

E. Outlet pull and junction box covers shall be painted red on the exterior and shall be installed in accord with Specification Section 26.

F. Pigtail and/or tapped connection will not be allowed on supervised circuit. Connections shall be made directly to and from device terminal screws.

G. Manual Pull Stations shall be suitable for flush or semi-flush mounting on standard single gang box or plaster ring, and shall be installed not less than 42 inches (106.68 cm) or more than 48 inches (1.22 m) to center of box above the finished floor.

H. All devices located at exterior or areas subject to damp conditions shall be listed for outdoor or weatherproof locations. Back-boxes for such devices shall be confirmed with manufacture and shall be installed per listing requirements.

I. The Office of the Campus Fire Marshal, prior to system programming, shall approve all protected premise and proprietary receiver fire alarm addressable custom labels. Design Builder is responsible for confirming final room numbers with University Representative prior to system programming.

J. Design Builder shall be responsible for coordination meetings with other appropriate trades to confirm operation of smoke/fire dampers, energy management systems, access control systems, intrusion systems, elevator, or other fire and life safety systems prior to and as needed during course of installation.

K. Design Builder shall coordinate and have programmable attributes of the fire alarm system reviewed by the Office of the Campus Fire Marshal prior to system programming.

3.2 TESTING AND REPORTS

A. Upon completion of the system's installation, a representative of the system manufacturer shall conduct a thorough acceptance test, as described by NFPA 72, of the system, witnessed by the Campus Fire Marshal and submit a written report of the results to the University Representative. The test shall include at least, verifying the following:

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

2. Close each sprinkler system control valve and verify proper supervisory alarm at the FACP.

3. Verify activation of all flow switches.

4. Open initiating device circuits and verify that the trouble signal actuates.

5. Open and short notification appliance circuits and verify that the trouble signal actuates.

6. Ground initiating device circuits and verify response of trouble signals.

7. Check all alarm notification devices for operation.

8. Check installation, supervision, and operation of smoke detectors.

9. Verify that each initiating device alarm signal is properly received and processed by the fire alarm control panel.

10. Functional operation of each alarm device and circuit.

11. Functional operation of each monitored device circuit.

12. Functional operation of each control circuit.

13. Conduct tests to verify trouble indications for common mode failures, such as alternating current power failure. Consult the manufacturer's manual for other common mode failures and conduct the described testing procedures.

14. A certified Powerscope report shall be provided for all 6 starnd of multi-mode fiber between the MRB and MS&E facility fire alarm network patch bay, measuring signal losses to neighboring panels on both sides of the protected premises.

3.3 TRAINING

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Location of training (on site, local training facility, or manufacturer’s district office) to be coordinated with University Representative.

3.4 FIELD QUALITY CONTROL

A. Final acceptance testing shall be witnessed by University’s Representative.

B. A final pre-test shall be witnessed by University’s Representative. Notification for testing and inspection required in writing 48 hours in advance.

C. Manufacturer's Field Service:

1. Engage a factory-authorized installation representative to assist during the installation, pre-testing and adjust of the fire alarm system and field devices, components and equipment.
2. Include a manufacturer’s field representative during all final acceptance testing.

D. ADJUSTING

1. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, the manufacturer shall provide on-site assistance in adjusting system to suit actual occupied conditions. The manufacturer shall provide up to two visits to Project outside normal occupancy hours for this purpose.

2. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72.

END OF SECTION 28 3111

SECTION 31 1000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Removing existing **trees, shrubs**, **groundcovers**, **plants and grass**.
2. Clearing and grubbing.
3. Stripping and stockpiling topsoil.
4. Removing above- and below-grade site improvements.
5. Disconnecting, capping or sealing, and removing site utilities.
6. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and temporary erosion and sedimentation control procedures.
2. Division 01 Section "Execution" for verifying utility locations and for recording field measurements.
3. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
4. Division 32 Section "Temporary Tree and Plant Protection" for protecting trees remaining on-site that are affected by site operations.

1.2 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.3 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain University property, cleared materials shall become design builder's property and shall be removed from Project site and legally disposed of at design builder's expense.

1.4 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

C. RIFA Certification: Submit certification form CA-1 from the Cooperative Red Imported Fire Ant (RIFA) Project stating that red imported fire ants are not present at the project site prior to grading or moving of soil.

1. If red imported fire ants are found at the Project site, establish and implement an approved pesticide treatment plan. Schedule reinspections from the Cooperative RIFA Project at least three days in advance.

1.5 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from University's Representative.
2. Provide alternate routes around closed or obstructed traffic ways if required by University's Representative.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on University's premises where indicated.

C. Utility Locator Service: Notify utility locator service and University's Representative before site clearing.

D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

B. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to University's Representative.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to a sediment and erosion control plan, specific to the site, that complies with EPA 832/R-92-005 or requirements of the University representative, whichever is more stringent and to comply with LEED Prerequisite SS 1, sediment and erosion control plan.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal following completion of permanent control measures.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by University's Representative.

1. Employ an arborist approved by University's Representative, to submit details of proposed repairs and to repair damage to trees and shrubs.

2. Replace trees that cannot be repaired and restored to full-growth status, as determined by University's Representative.

3.4 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Provide a minimum of 14 days' notice to University's Representative and receive written authorization to proceed before interrupting any utility.
2. University will interrupt and return to service the existing utilities.

B. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.
5. Chip removed tree branches and dispose of off-site at an approved site, at design builder's expense. If disposed of off-site, provided University's Representative with quantity of material dispensed of.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off University's property at design builders' expense.

1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 31 1000

SECTION 31 2000 – EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling for utility trenches.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:

1. Division 01 Section "Allowances" for quantity allowance provisions related to unit-price rock excavation and authorized additional excavation.
2. Division 01 Section "Unit Prices" for unit-price rock excavation and authorized additional excavation provisions.
3. Division 01 Sections "Construction Progress Documentation" and "Photographic Documentation" for recording pre-excavation and earthwork progress.
4. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
5. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
6. Divisions 21, 22, 23, 26, 27, and 28 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
7. Divisions 22, 23, 26 and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
8. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
9. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.
10. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
11. Division 31 Section "Drilled Concrete Piers and Shafts " for excavation of shafts and disposal of surplus excavated material.

12. Division 32 Section "Temporary Tree and Plant Protection" for protecting and trimming trees to remain.

13. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.
14. Division 32 Section “Plants" for planting bed establishment and tree and shrub pit excavation and planting.
15. Division 33 Section "Subdrainage" for drainage of foundations, slabs-on-grade, walls and landscaped areas.

1.2 UNIT PRICES

A. Unit prices for earthwork are included in Division 01 Section "Unit Prices."

B. Quantity allowances for earthwork are included in Division 01 Section "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24 inches outside of concrete forms other than at footings.
2. 12 inches outside of concrete forms at footings.
3. 6 inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6 inches beneath bottom of concrete slabs-on-grade.
6. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt or P.C.C. paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by University's Representative. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by University's Representative. Unauthorized excavation, as well as remedial work directed by University's Representative, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. Yd or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Geotextile.
3. Controlled low-strength material, including design mixture.
4. Geofoam.

B. Samples: 12-by-12-inch Sample of subdrainage and separation geotextile.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 1557 for each on-site and borrow soil material proposed for fill and backfill.

D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

E. RIFA Certification: Refer to Division 31 Section “Site Clearing” for submittal requirements.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving University’s facilities unless permitted in writing by University’s Representative and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify University’s Representative not less than 14 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without University’s Representative's written permission.
3. Contact utility-locator service for area where Project is located before excavating.
4. University’s staff will interrupt existing utilities and return them to service.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1inch sieve and 0 to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater

than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:

1. Portland Cement: ASTM C 150, Type II or V.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869.
5. Water: ASTM C 94/C 94M.
6. Air-Entraining Admixture: ASTM C 260.

B. Produce conventional-weight, controlled low-strength material with 140-psi compressive strength when tested according to ASTM C 495.

2.4 GEOFOAM

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60 lb/cu. ft..

B. Molded-Polystyrene Board Insulation: ASTM C 578, Type VIII, 1.15 lb/cu. ft..

1. Manufacture molded polystyrene with an inorganic mineral registered with the EPA and suitable for application as a termite deterrent.

C. Geofoam Connectors: Geofoam manufacturer's multibarbed galvanized steel sheet connectors.

2.5 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red – Electrical
2. Yellow – Gas, oil, steam and dangerous materials.
3. Orange – Telephone and other communications.
4. Blue – Water Systems.
5. Green – Sewer Systems.
6. Purple – Reclaimed water systems

B. Tracer Wire: provide tracer wire as specified in other Sections. Tracer wire shall be minimum 12 AWG, solid, insulated copper wire.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system**,** specified in Division 31 Section "Dewatering," to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified by design builder per paragraph 1.5 above and cross sectioned by University's Representative. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

    a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

    a. 24 inches outside of concrete forms other than at footings.
    b. 12 inches outside of concrete forms at footings.
    c. 6 inches outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. 6 inches beneath bottom of concrete slabs on grade.
    f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

A. Notify University's Representative when excavations have reached required subgrade.

B. If University's Representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction**,** repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by University's Representative, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by University's Representative, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by University's Representative.

1. Fill unauthorized excavations under other construction or utility pipe as directed by University's Representative.

3.10 STORAGE OF SOIL MATERIALS

Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before acceptance by University's Representative and completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

D. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.

G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation. See Article "Compaction of Soil Backfills and Fills" for compaction requirement.

I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

J. Install continuous tracer wire directly on top of all non-ferrous pipes and attach at 10-foot intervals. Terminate by bringing to the surface at ends of the buried run and attach to exposed pipe or other adjacent structure.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud.

3.15 SOIL MOISTURE CONTROL

Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inchesin loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 1557 with a minimum of two passes of a plate-type vibratory compactor.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 1557 with a minimum of two passes of a plate-type vibratory compactor.
2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.19 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase and base course to required crown elevations and cross-slope grades.
4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.20 DRAINAGE COURSE

Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabson-grade as follows:

1. Install sub drainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.21 FIELD QUALITY CONTROL

A. Testing Agency: University will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by University's Representative.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. Or less of paved area or building slab, but in no cases fewer than 3 tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by University's Representative; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Coordinate with requirements in Division 31 Section “Site Clearing.” Coordinate soil storage requirements with University’s Representative.

B. Disposal: Transport surplus satisfactory soil; waste material including unsatisfactory soil; trash; and debris; and legally dispose of it off University's property at design builder’s expense.

END OF SECTION 31 2000

SECTION 31 5000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes temporary excavation support and protection systems.

B. Related Sections include the following:

1. Division 01 Section "Construction Progress Documentation" and "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.
3. Division 03 Section "Shotcrete" for use in excavation support and protection.
4. Division 31 Section "Earth Moving" for excavating and backfilling
5. Division 31 Section "Dewatering" for dewatering excavations.

1.2 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified California Registered Professional Engineer.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.
4. Monitor vibrations, settlements, and movements.

1.3 SUBMITTALS

A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.

1. Include Shop Drawings signed and sealed by the qualified California Registered Professional Engineer responsible for their preparation.

B. Qualification Data: For Installer and professional engineer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by University or others unless permitted in writing by University's Representative and then only after arranging to provide temporary utility services according to requirements indicated.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly re-survey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify University's Representative if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36, ASTM A 690, or ASTM A 992.

C. Steel Sheet Piling: ASTM A 328, ASTM A 572, or ASTM A 690; with continuous interlocks.

1. Corners: Site-fabricated mechanical interlock or Roll-formed corner shape with continuous interlock.

D. Wood Lagging: 3 inches, 4 inches No. 2 Douglas Fir Larch or better.

E. Shotcrete: Comply with Division 03 Section "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.

F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

G. Reinforcing Bars: ASTM A 615, Grade 60 (Grade 420), deformed.

H. Tiebacks: Steel bars, ASTM A 722.

I. Slurry Cement Backfill: State of CA Standard Specifications (Caltrans 2010) section 19-3.02D.

i Slurry cement backfill must be a fluid workable mixture of aggregate, cement, and water.

ii Cement must comply with section 90-1.02B(2) except testing is not required.

iii Water must be free from oil, salts, and other impurities that adversely affect the backfill.

iv Aggregate must be one of the following:

1 Commercial-quality concrete sand

2 Excavated or imported material in any combination, free of organic material and other deleterious substances and complying with the grading requirements shown in the following table:

Sieve Size	Percentage Passing
1-1/2”	100
1”	80-100
3/4"	60-100
3/8”	50-100
No. 4	40-80
No. 100	10-40

Proportion slurry cement backfill by weight or volume. Use at least 188 pounds of cement per cubic yard. Use sufficient water to produce a fluid workable mix that flows and can be pumped without segregation during placement.

Mix materials thoroughly by machine. Use a pugmill, rotary drum, or other authorized mixer. Mix until cement and water are thoroughly dispersed.

You may use slurry cement backfill as structure backfill for pipe culverts.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from University's Representative. Provide alternate routes around closed or obstructed traffic ways if required by University's Representative.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces is not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER BEAMS AND LAGGING

A. Install steel soldier beams before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier beams at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at centers indicated and secure to soldier beams.

3.4 TIEBACKS

A. Tiebacks: Drill for, install, grout, and tension tiebacks into position. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Test loading shall be observed by a qualified California Registered Professional Engineer responsible for design of excavation support and protection system.
2. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by University's Representative.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

B. Only with the University's approval shall excavation support and protection systems be permanently left in place.

END OF SECTION 31 5000

SECTION 31 6329 - DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Dry-installed drilled piers.
2. Slurry displacement-installed drilled piers.
3. Dry-installed or slurry displacement-installed drilled piers, at Contractor's choice.

B. Related Sections include the following:

1. Division 03 Section “Cast in Place Concrete” for general structural and building applications of concrete.
2. Division 03 Section “Concrete Reinforcement.”

1.3 REFERENCES

A. Standards listed below apply where designation is cited in this Section. Where the applicable year of adoption or revision is not listed below, the latest edition applies.

B. American Concrete Institute (ACI): Use applicable year of adoption or revision as published in the “ACI Manual of Concrete Practice”.

1. ACI 336.1: Standard Specification for the Construction of Drilled Piers.

C. American Society for Testing and Materials (ASTM): Use applicable year of adoption or revision as published in the “Annual Book of ASTM Standards”.

1. ASTM A 252: Specification for Welded and Seamless Pipe Piles.
2. ASTM A 36: Standard Specification for Carbon Structural Steel.

D. CBC: 2013 California Building Code

E. Evaluation Report: Where designated in this Section, products shall have an active Evaluation Report evidencing compliance with provisions of the International Building Code. Reports are available at www.icc-es.org and www.iapmoes.org.

F. Geotechnical Report:

1.4 SUBMITTALS

A. Submittal procedures and administrative provisions are established by Division 01 Section "Submittals".

B. Product Data: For each type of product indicated.

C. Design Mixes: For each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

D. Shop Drawings: For concrete reinforcement detailing fabricating, bending, and placing.

E. Shaft Drilling Reports: Record of as-built pier location, diameter, tip elevation, cut off elevation, reinforcing and concrete placement.

F. Submit pier installation and proposed temporary shaft protection plan to the Geotechnical Engineer of Record (GEOR) at least three weeks prior to mobilization.

1. The installation and shaft protection plan shall provide information on the following:

a. Name and experience record of the drilled pier superintendent who will be in charge of drilled pier operations for the project.
b. List of proposed equipment to be used, including cranes, drills, augers, bailing buckets, final cleaning equipment, de-sanding equipment, slurry pumps, core sampling equipment, tremies, concrete pumps, casing.
c. Details of overall construction operation sequence and the sequence and schedule of shaft construction.
d. Details of shaft excavation methods.
e. When the use of slurry is anticipated, details of the mix design and its suitability for the subsurface conditions at the construction site, mixing and storage methods, maintenance methods, disposal procedures, slurry mixing procedures, pumping and handling equipment, testing procedures, slurry cleaning procedures, recycling and disposal procedures.
f. Details of methods to clean the shaft excavation.
g. Details of reinforcement placement, including support and centralization methods.
h. Details of concrete placement, including proposed operational procedures for free fall, tremie or pumping methods.
i. Details of casing installation and removal methods.

2. The GEOR will evaluate the drilled pier installation plan for conformance with the plans, specifications and special provisions. Within 14 days after receipt of the installation plan, the GEOR will notify the contractor of any additional information required and or changes necessary to meet the contract requirements.

G. Submit a survey plan locating new drilled piers after installation. Actual pier locations and pier reinforcement to be coordinated with pier cap reinforcement.

H. Submit a concrete placement procedure for drilled piers for 30 minutes maximum interruption of placement. The procedure shall include a contingency plan that gives an additional 15 minutes of interruption of placement.

1.5 QUALITY ASSURANCE

A. Contractor Qualifications:

1. Minimum of 3 successful projects with similar soil conditions, shaft sizes, depth and volumes of work contained in this project.
2. Submit proof of compliance within 30 days after "Notice to Proceed."

B. Drilled Pier Standard: Comply with provisions in ACI 336.1.

C. Survey Work: Engage a California licensed land surveyor to perform surveys, layouts and measurements for drilled pier work.

1. Conduct layout work for each pier to lines and levels required before excavation and actual measurements of each pier's horizontal axial location, shaft diameter, bottom and top elevations, deviations from specified tolerances and other data as required.
2. Record and maintain information pertinent to each pier and cooperate with other testing and inspection personnel to provide data required for reports.
3. The Geotechnical Engineer of Record will inspect shafts prior to and after the installation of reinforcement, test soil materials and verify pier depth. The Geotechnical engineer will also inspect shafts prior to concrete placement.
4. If the Geotechnical Engineer's inspection determines that there is loose material in the shaft excavation, the Contractor will clean the hole as directed by the Geotechnical Engineer, including the removal of the reinforcing cage as required.
5. The University's Testing Agency will inspect installation of reinforcing and placement of concrete in drilled piers.
6. Materials and installed work may require testing and retesting at any time during the progress of work. Allow free access to material stockpiles and facilities.

1.6 PROJECT CONDITIONS

A. Subsurface Information: Refer to Geotechnical Report.

B. Existing Utilities: Locate existing underground utilities by careful hand excavation before starting shaft excavation operations.

1. If utilities are to remain in place, provide protection from damage during construction operations.
2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the design team immediately for directions as to procedure.
3. Cooperate with the University and public and private utility companies in keeping their respective service and facilities in operation at all times.
4. Repair damaged utilities to the satisfaction of the utility owner.
5. Do not interrupt existing utility serving facilities occupied and used by Owner or others, except where permitted in writing by the University's Representative and then only after acceptable temporary utility services have been provided.

C. Environmental Requirements: Groundwater is expected to be encountered during drilling. See Geotechnical Report for expected depth.

1. Provide adequate temporary drainage to prevent shaft instability.
2. Pump shafts when directed by the Geotechnical Engineer.

D. Barricade excavations as required in accordance with Division 1 Section "Temporary Facilities and Controls."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Reinforcement: See Division 3 Section "Concrete Reinforcement."

B. Concrete Materials: See Division 3 Section "Cast-in-Place Concrete."

C. Steel Pipe Casings: ASTM A 283, Grade C; or ASTM A 36, carbon-steel plate, with joints full-penetration welded according to AWS D1.1.

D. Slurry: Pulverized sodium bentonite, pulverized attapulgite, or polymers, mixed with water to form stable colloidal suspension; complying with ACI 336.1 for density, viscosity, sand content, and pH. Super Mud manufactured by PDS Company Inc. or approved equal. To be used in accordance with manufacturer's recommendations.

E. Concrete Mix:

1. Prepare design mixes according to ACI 211.1 and ACI 301 for each type and strength of concrete determined by either laboratory trial mix or field test databases. Mix designs shall be stamped and signed by a registered Civil or Structural engineer licensed in the state of California. Contractor shall bear all costs for concrete mix designs.

    a. Use a qualified testing agency for preparing and reporting proposed mix designs for laboratory trial mix basis.

2. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:

    a. Compressive Strength (28 Days): 5,000 psi.
    b. Minimum Slump: Capable of maintaining the following slump until completion of placement:

        1) 4 inches for dry, uncased, or permanent-cased drilling method.
        2) 6 inches for temporary-casing drilling method.
        3) 7 inches for slurry displacement method.

F. Do not air entrain concrete for drilled piers.

G. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.

H. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

I. Concrete-mix design adjustments may be considered if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant. Resubmit and obtain approval of proposed changes to concrete-mix proportions

PART 3 - EXECUTION

3.1 DESIGN

A. Construct pier reinforcement cage per contract documents and to allow for insertion of a tremie tube for concrete placement. Reinforcing cage shall be free of irregularities that could interfere with insertion and removal of the tremie.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.3 EXAMINATION

A. Examine site conditions prior to commencement of drilling shafts.

B. Notify immediately the University and the design team in writing in the event of unsatisfactory site conditions, indicating the nature of extent of unsatisfactory conditions.

C. Protect adjacent affected structures from damage.

D. Notify the University's Representative at least two workdays prior to commencing work.

3.4 SHAFT EXCAVATION

A. Excavate shaft for piers to lengths shown on the drawings. Pier holes shall be reamed with a bucket and auger prior to steel reinforcement cage installation.

1. Excavate shafts only after adjacent holes with 2.5 pier diameters are filled with concrete and allowed to set for at least 24 hours.

B. Temporary Shaft Protection:

1. Temporary shaft protection is the responsibility of the contractor.
2. Temporary casing and/or drilling slurry shall be required for shaft protection of piers extending below the water table.
3. Temporary casings shall have sufficient thickness to withstand compressive and withdrawal stresses as required to maintain shaft walls without displacing.
4. Remove and replace or repair casings which are damaged during installation and which could impair the strength or efficiency of the completed pier.
5. Remove all casings after placing concrete.
6. The drilling slurry shall be maintained at least six feet above the groundwater level in order to provide adequate support to soil on the walls of the drilled pier excavations.
7. Drilling slurry shall be mixed in external tanks with adequate agitation for the slurry to become uniformly mixed, self-suspending and free of lumps. The slurry shall be mixed in accordance with the manufacturer's recommendations. pH and marsh funnel viscosity testing of the slurry shall be performed before introducing slurry to the drilled hole.
8. During drilling and prior to concrete placement, slurry shall be sampled from the top and bottom of each pier excavation using a double ball bailer. The slurry samples shall be tested for pH, marsh funnel viscosity, sand content and specific weight to confirm that the

slurry properties are within the range of the manufacturer's recommendations. Slurry mix testing shall be performed by individuals trained by the manufacturer's representative. Slurry may be recycled for use on subsequent piers.

C. Construction Tolerances:

1. Maximum permissible variation of location at top of pier: Not more than 1/24 of the shaft diameter or 3 inches, whichever is less.
2. Maximum shaft out-of-plumb: Not be more than 1.5 percent of length nor exceeding 12.5 percent of shaft diameter or 15 inches, whichever is less.
3. Concrete cut-off elevation: Plus 1 inch or minus 3 inches.
4. If above tolerances are exceeded, submit additional or corrective construction to compensate for excessive eccentricity.
5. Submit proposed corrective construction methods to the University's Representative and to the design team for review before proceeding.

D. Obstructions:

1. Use core barrels with drilling equipment, hand labor using air-powered tools or other safe methods to remove rock, boulders and obstructions.
2. Dispose of excavated material in accordance as required by the Specifications.

3.5 DEWATERING

A. Comply with requirements of Division 1 Section "Temporary Facilities and Controls."

3.6 OVER EXCAVATION

A. No payment will be made for extra length when shafts are excavated to a greater depth than required or authorized by the Geotechnical Engineer, due to overdrilling.

B. Complete pier depth and fill extra depth with approved concrete if other conditions are satisfactory.

3.7 REINFORCING STEEL

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement. See Division 3 Section "Concrete Reinforcement."

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement. Use 4 approved spacers equally spaced around the cage. Longitudinal spacing shall not be more than 10-15 feet between spacers to be tied to the cage.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather and to ensure smooth movement of the tremie.

G. Reinforcing cages must be placed in the same shift that concrete placement occurs. Cages will not be allowed to stay in the hole until the next work shift. Reaming shaft, inspection of shaft, placement of cage, final inspection of shaft and concrete placement should take place in continuous sequence of operations without interruption.

3.8 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's Geotechnical Engineer, Owner's independent testing and inspecting agency. Provide protection sheets extending at least 12 inches beyond the edges of excavation opening.

A. Dry Method: Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.

1. Where concrete cannot be directed down shaft without striking reinforcing, place concrete with chutes, tremies, or pumps.
2. Vibrate top 60 inches of concrete.

B. Slurry Displacement Method: Place concrete in slurry-filled shafts by tremie methods or pumping. Control placement operations to ensure that tremie or pump pipe is embedded no fewer than 60 inches into concrete, and flow of concrete is continuous from bottom to top of drilled pier without segregating the mixed materials.

C. Maintain sufficient pressure head of concrete to prevent reduction in diameter of shaft by earth pressure and to prevent extraneous material from mixing with fresh concrete.

D. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.

E. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

F. Interrupted placing operations of over 45 minutes shall not be permitted.

G. Remove excess laitance and slurry contaminated concrete using vacuum truck or other approved means to cut off elevation and backfill hole to working grade with clean sand.

H. Hot and Cold Weather Placement: Provide in accordance with provisions of Division 3 Section "Cast-in-Place Concrete."

3.9 FIELD QUALITY CONTROL

A. Provide field quality control testing and inspection for concrete and reinforcing steel as specified in Division 3 Section "Concrete Reinforcement" and Section "Cast-in-Place Concrete."

B. Notify the University and the Geotechnical Engineer at least 48 hours prior to time that excavations will be ready for inspection and tests.

C. Provide facilities as required to assist inspection and testing of excavations and cooperate with inspecting and testing personnel to expedite work.

D. Geotechnical Engineer of Record (Hired by the contractor):

1. Inspect and report results.
2. Conduct inspections and provide reports as soon as possible so as not to delay concrete placement for acceptable excavations.
3. Inspect shaft borings prior to installation of reinforcement, test soil materials and confirm pier depth.

E. Testing Agency (Hired by the contractor):

1. Inspect placement of concrete and reinforcement per Division 3 Section "Cast-in-Place Concrete."

F. Perform slurry testing and provide results to the design team in accordance with approved Pier Installation Plan.

END OF SECTION

SECTION 32 0190 — LANDSCAPE MAINTENANCE PERIOD

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Monitoring and Maintenance of Plant Material, Including Existing Trees to Remain.
2. Monitoring and Maintenance of Irrigation Systems.
3. Maintenance of Wood Chip Mulch.
4. Maintenance of Tree Staking Systems.
5. Monitoring and Control of Pests (insects, disease, mites and any other pathogen) on Plant Material, Grasses, Succulent and Cacti, Including Existing Trees to Remain.
6. Monitoring of Watering on Plant Material, Plant Material, Grasses, Succulent and Cacti.
7. Application of Fertilizers and Weed Control on Plant Material, Succulent and Cacti, Including Existing Trees to Remain.

B. Related Sections:

1. Section 32 84 00, Planting Irrigation.
2. Section 32 91 13, Planting Soil Preparation.
3. Section 32 92 21, Meadow Seeding.
4. Section 32 92 23, Lawn Sodding.
5. Section 32 93 00, Planting Materials.

C. Unit Prices:

1. Provide a unit price for each chemical application indicated in the Preliminary Chemical Application Schedule under Article 3.11 in this Section to establish a bid price.
2. Provide a unit price for each fertilizer application, based on the preliminary fertilization programs indicated in this Section to establish a bid price.
3. Unit prices shall be applicable for the cost of additional chemical and fertilizer applications required beyond the quantity of applications included in the bid and shall be applicable for crediting the Owner for applications included in the bid price which are not required by the Horticultural Consultant.
4. Credit Owner for any chemical or fertilizer applications included in the bid price which are not required by the Horticultural Consultant.

1.2 REFERENCES

A. ANSI — American National Standards Institute:

1. Z60.1 — American Standard for Nursery Stock, Current Edition.
2. A 300 — Trees, Shrubs, and Other Woody Plant Maintenance — Standard Practice.

B. ASTM — ASTM International: D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. ICBN — International Code of Botanical Nomenclature.

D. ICNCP — International Code of Nomenclature of Cultivated Plants.

1.3 DEFINITIONS

A. IPM — Integrated Pest Management: An approach to pest control that utilizes regular monitoring to determine if and when treatments are needed and employs physical, mechanical, cultural, biological and educational tactics to keep pest numbers low enough to prevent intolerable damage or annoyance. Least-toxic chemical controls are used as a last resort.

B. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

C. Excessive Compaction of Soil: Planting area soil compaction greater than 75 percent dry density, as determined by ASTM D 1557.

D. Horticultural Consultant for Construction Period and until Commencement of One-Year Maintenance Period: Horticultural consultant employed by Landscape Architect for Project.

E. Horticultural Consultant for the One-Year Maintenance Period after Date of Final Completion: Horticultural consultant employed by Contractor to provide field quality control inspections and reports for project.

F. Landscape Architect: Landscape Architect employed by the Owner to provide professional landscape architectural services for the Project.

1.4 SUBMITTALS

A. General Requirements: Refer to Division 1.

B. Product Purchase and Delivery Documentation: Fertilizer: Within 5 working days of each application submit purchase orders, invoices and receipts showing supplier name and address, person who sold product, date of purchase, specific product purchased, quantity purchased, and delivery date.

C. Maintenance Log:

1. Maintain a daily record of work performed until Owner acceptance of maintenance.
2. Include precipitation records from on-site rain gauge; time and duration of each water application; chemical and fertilizer applications; irrigation problems; drainage problems; soil temperatures; visual observations of plants, including lawn sod; mowing activity; tests performed; and moisture sensor readings.
3. Make log available for review at any time by the Owner, the Horticultural Consultant, and the Landscape Architect.

4. At end of maintenance period, submit to the Owner a complete and chronologically organized maintenance log as a digital file, saved in Microsoft Office® format, and one printed copy.

D. Documentation of Accepted Conditions: Within 7 working days after the Owner's acceptance of maintenance, submit color photographs and a written report documenting the Owner's accepted conditions of the plant material.

E. Certificates: Certificate indicating chemical applicator is currently certified by the State of Texas for commercial application, name of applicator, and State of Texas license number.

F. Plant Condition Inspection Reports: Plant inspection report documenting damage and signs of stress due to pests and disease, nutritional deficiencies, watering or any other problem submitted via e-mail to the Owner, the Landscape Architect, and the Horticultural Consultant within 2 days of observation.

G. Landscape Architect and Horticultural Consultant Inspection Reports: Plant inspection report documenting damage and signs of stress due to pests and disease, nutritional deficiencies, watering or any other problem submitted via e-mail to the Contractor for immediate action within 24 hours to reverse problems.

H. Test Reports: Soil test reports for soil samples taken from plant material (tree, shrub, ground cover, turf and wildflower meadow including existing trees to remain).

1.5 QUALITY ASSURANCE

A. Landscape Maintenance Contractor Qualifications:

1. Demonstrated experience in maintenance of commercial landscape projects.
2. Demonstrated experience in landscape maintenance supervision, with experience and training in integrated pest management, turf management, entomology, pest control, soils, fertilizers and plant identification.
3. Thoroughly familiar and trained in the work to be accomplished and perform the task in a competent efficient manner.
4. Directly employs and supervises the Work force at all times.
5. Must notify the Owner's Designated Representative of changes in supervision.
6. Provide proper identification for landscape maintenance firm's labor force.

B. Regulatory Requirements:

1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
2. Provide for inspections and permits required by Federal, State, or local authorities in furnishing, transporting, and installing of chemicals.
3. Keep on site a record of all herbicides, pesticides, and fungicides used to include MSDS sheets and any information required by law such as wind speed at application time, rate of application and target pest, pathogen or weed. This information should be ready to submit upon request by law to any employee of the City, County, or State Regulatory Offices.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Plant Material: Meet requirements of Section 329300.

1.7 SITE CONDITIONS

A. Environmental Requirements: Do not apply chemicals during windy conditions.

1.8 SEQUENCING AND SCHEDULING

A. Work Schedule:

1. Perform maintenance during normal working hours, except for emergencies.
2. Be present at the project site 7 days per week including holidays, to perform specified maintenance.

B. Chemical Applications:

1. Notify the Owner's Designated Representative and Horticultural Consultant 48 hours in advance of required chemical applications.
2. Obtain the Owner's Designated Representative's and Horticultural Consultant's approval of application schedule.

PART 2 PRODUCTS

2.1 MATERIALS

A. Replacement Plant Material:

1. Match existing genus, species, cultivar and size.
2. Meet requirements of Section 02930.
3. Meet requirements of ANSI Z60.1, ICBN and ICNCP.

B. Seed: Match existing genus, species, varieties and cultivars.

C. Fertilizers for Trees: Depending upon soil nutrition based on soil tests, deep root fertilize all trees with a combination of PHC for trees 27-9-9 and Mycor Tree Injectable. Or apply InjectoFeed 32-7-7 and AgriPlex Micro-Mix 0-4-4 with 2-percent magnesium, 2-percent water soluble magnesium, 3-percent sulfur, 0.02-percent boron, 5-percent iron, 0.5-percent manganese, and 0.5-percent zinc.

D. Fertilizer for Shrubs and Ground Cover: Fertilize with Anderson 18-6-12 (granular) or a 3-1-2 ratio such as 18-6-12 granular fertilizer with 50 percent of the available Nitrogen being slow-release Nitroform and 50 percent being slow-release Nutralene, Monoammonium phosphate as a phosphorous source, 13-percent sulfur, 4-percent calcium, 0.5-percent magnesium, 5-percent Ruffin iron, and 0.5-percent zinc.

E. Fertilizer for Turf and Meadow Areas: Apply Anderson 18-6-12 (granular) or a 3-1-2 ratio such as 18-6-12 granular fertilizer with 50 percent of the available nitrogen being slow release Nitroform, 50 percent being slow release Nutralene, the phosphorous source being monoammonium phosphate, 13 percent sulfur, 4 percent calcium, 0.5 percent manganese, 0.5 percent magnesium, 5 percent Ruffin iron, and 0.5 percent zinc.

F. Pesticides, Insecticides, Herbicides, Fungicides and Minor Element Packets: Legal commercial-quality non-staining materials with original manufacturers' containers, properly labeled with guaranteed analysis, least toxic required.

G. Replacement Staking Materials: Same as original installation.

H. Wood Chip Mulch: As specified in Section 329300.

PART 3 EXECUTION

3.1 PREPARATION

A. Protection of Existing Conditions:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
2. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
3. Provide barricades, fences or other barriers to protect existing conditions from damage during maintenance operations.
4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants.
5. Submit written notification of damaged plants and structures to the Owner's Designated Representative immediately.

3.2 GENERAL MAINTENANCE

A. Maintenance Period:

1. Continuously maintain nursery-grown and field-collected plant material from time of plant delivery, during progress of Work, and for a minimum period of 1 year after date of Final Completion to include all weekends and holidays until the Owner accepts maintenance responsibility of plant material.
2. Continuously maintain irrigation system during progress of Work, and for a minimum period of 1 year after date of Final Completion to include all weekends and holidays until the Owner accepts maintenance responsibility of the plant material.
3. Continuously maintain existing trees to remain from time of construction commencement, during progress of Work, and for a minimum period of 1 year after date of Final Completion to include all weekends and holidays, until the Owner accepts maintenance responsibility of plant material.

B. Integrated Pest Management: Employ principles of integrated pest management for each aspect of maintenance.

C. Dust Removal: Continuously remove construction dust from all plant material from time of plant delivery, during progress of Work, and for a minimum period of 1 year after date of Final Completion to include all weekends and holidays until the Owner accepts maintenance responsibility of plant material.

3.3 TREE MAINTENANCE

A. General Watering:

1. Using a soil sample tube, tensiometers and soil probe, check rootball moisture and surrounding soil moisture at representative plants at least twice a week.
2. Maintain watering basins around trees and shrubs if required to adequately apply water to root zones.
3. Open basins to allow surface drainage away from the root crown when excess water accumulates and restore watering basins when needed to adequately water root balls.
4. Remove watering basin berms at the end of the maintenance period and form mulch area around trees as indicated on the Drawings.
5. Adjust frequency and length of time for watering cycles according to changing soil and weather conditions.
6. When some plants but not every plant within a valve zone require supplemental water due to varying soil or microclimate conditions, apply supplemental water to watering basins by hand using a hose and water wand to break the water force.
7. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.
8. Maintain depth of mulch to reduce evaporation and frequency of watering.

B. Settled or Leaning Plants: Reset plants to proper grades or upright position when weather and soil conditions permit.

C. Weed Control:

1. Keep mulched areas between plants and watering basins weed free.
2. As a last resort use least toxic herbicides.
3. Avoid frequent soil cultivation that destroys shallow roots.
4. When applying any weed control, follow all label instructions for rates and application instructions. Do not apply against label.

D. Preliminary Fertilization Program to Establish Bid Price:

1. Fertilize trees on February 1, April 1, June 1, and August 1 unless directed otherwise by the Horticultural Consultant.
2. Fertilize all trees with a combination of PHC for trees 27-9-9 and Mycor Tree Injectable. Mix 8 pounds of PHC for trees and A and B packets of Mycor Tree Injectable per 100 gallons of water. Apply this solution by drenching top or rootball at the rate of five gallons per inch trunk diameter measured at breast height. Keep fertilizer solution agitated during application. Or mix 20 pounds of Injecto-Feed 32-7-7 and 1 gallon of

Agri-Plex 0-4-4 in 100 gallons of water, and slowly and uniformly drench top of each root ball with 10 to 15 gallons of the fertilizer solution. Horticultural Consultant will direct which fertilizer to use at each application based on soil tests and vigor of trees.

3. Irrigate trees on same day of fertilizer application by operating spray heads for 20–30 minutes and 45–60 minutes for rotary heads, unless directed otherwise by the Horticultural Consultant.
4. Water in short cycles so that run-off does not occur.

E. Final Fertilization Program: Apply fertilizer as directed in writing by the Landscape Architect after the Horticultural Consultant determines the fertilization requirements based on soil test data.

F. General Tree Pruning:

1. Meet requirements of ANSI A300 for Definitions, Pruning Tools and Equipment, Pruning Cuts, and Wound Treatment.
2. Perform crown cleaning to eliminate weak branches, water sprouts, dead growth, dying growth, diseased growth, and damaged growth.
3. Perform crown thinning to reduce toppling and wind damage.
4. Perform crown reduction and shaping to maintain growth within space limitations and maintain a natural appearance, as directed by the Horticultural Consultant in the field.
5. Retain lower branches in a “tipped back” or pinched condition to promote caliper trunk growth.
6. Do not cut back to fewer than six buds or leaves on branches.
7. Prune damaged trees or those that constitute health or safety hazards at any time of year.

G. Tree Staking:

1. Inspect stakes and ties at least once a week to check for rubbing that causes bark wounds.
2. Adjust tree stakes and ties as often as required to allow tree caliper growth and prevent bark wounds.
3. Replace defective materials with materials to match original materials.

H. Replacement of Plants: Replace, at no additional cost to the Owner, and as soon as weather conditions permit, plants not in a vigorous, thriving condition, during and at the end of the maintenance period.

3.4 SHRUBS AND GROUND COVERS

A. Watering:

1. Using a soil sampling tube, tensiometer and soil probe, check for moisture penetration throughout the root zone at least twice a week.
2. Water as frequently as necessary to maintain healthy growth of ground covers.
3. Adjust frequency and length of time for watering cycles according to changing soil and weather conditions.

B. Weed Control:

1. Maintain continuous, uniform mulch layer.
2. Control weeds via manual extraction to the degree practical.
3. Minimize hoeing of weeds to avoid plant damage.
4. As a last resort use least toxic herbicides required.
5. Apply a pre-emerge herbicide Snapshot, Ronstar, Barricade, or Gallery, or a combination of these herbicides in February, May, and September for control of summer and winter weeds.
6. Spot treat perennial grasses such as bermudagrass and dalisgrass with glyophosate, Fusilade or Acclaim.
7. Apply Image, Manage, or Sedgehammer for nutgrass control.
8. Apply Ornamec to control other grasses.
9. When applying any weed control, follow all label instructions for rates and application instructions. Do not apply against label.

C. Fertilizer Application:

1. Fertilize ground cover 3 times per year in February, May, and July.
2. Apply dry fertilizers with either a broadcast centrifugal or gravity spreader on planting bed areas.
3. Uniformly apply 2-1/2 pounds of actual Nitrogen per 1,000 square feet. Apply fertilizers evenly over planting areas by spreading half the fertilizer in one direction and half in a direction 90 degrees to the first direction to assure even application.
4. Apply dry fertilizers with either a broadcast centrifugal or gravity spreader on planting bed areas.
5. Water planting areas thoroughly after application. Irrigate plants on the same day of application for 20 to 30 minutes at spray heads and 45 to 60 minutes at rotary heads. Water in short cycles so that run-off does not occur.

D. Final Fertilization Program: Apply fertilizer as directed in writing by the Landscape Architect after Horticultural Consultant determines the fertilization requirements based on soil test data.

E. Replacement of Shrubs and Ground Cover: Replace, at no additional cost to the Owner, and as soon as soil and weather conditions permit, shrub and ground cover plants not in vigorous, thriving condition, during and at the end of the maintenance period.

3.5 LAWN

A. Watering:

1. Using a soil sampling tube, tensiometers and soil probe, check for moisture penetration throughout the root zone at least twice a week.
2. Water lawns at such frequency as weather conditions require, to replenish soil moisture to 6 inches below root zone.
3. Provide a total of 1 1/2 inches of water weekly during hot summer weather, in 3 applications per week.
4. Water at night if irrigation system is electrically controlled. Otherwise, watering shall be done during early mornings.

B. Weed Control:

1. As a last resort, control broadleaf weeds with least toxic herbicides.
2. Coordinate application of herbicides with thatch control.
3. Apply pre-emerge herbicide such as Barricade or Gallery or a combination of these products in February and May for control of summer weeds.
4. Apply post-emerge herbicides Certainty, Pendulum, Image or Blade for control of grassy and broadleaf weeds.
5. Apply post-emerge herbicides Lontrel, Speed Zone Southern, Blade or Prompt, for control of broadleaf weeds.
6. Apply post-emerge herbicides Certainty, Prompt, Image or Manage for control of sedges.
7. When applying any weed control, follow all label instructions for rates and application instructions. Do not apply against label.

C. Mowing and Edging:

1. Mow to a height of 2 1/2 inches when it reaches a height of 3 inches.
2. Trim edges weekly or as needed for neat appearance.
3. Remove and dispose of grass clippings.

D. Fertilizer Application:

1. Uniformly apply 18-6-12 at rate of 2 pounds actual nitrogen per 1,000 square feet, 4 times per year in March, May, July, and September.
2. Meet requirements of fertilizer manufacturer's current printed instructions.
3. Apply fertilizers evenly over planting areas by spreading half the fertilizer in one direction and half in a direction 90 degrees to the first direction to assure even application.
4. Apply dry fertilizers with a gravity or a broadcast centrifugal spreader.
5. Apply liquid fertilizers with a metered sprayer.
6. Water planting areas thoroughly after fertilizer application.
7. If turf is chlorotic, treat with a minor element package as directed by Horticultural Consultant for Owner.

E. Resodding of Lawn Areas: Replace, at no additional cost to the Owner, and as soon as weather conditions permit, lawn areas not in a vigorous, thriving condition, during and at the end of the maintenance period.

F. Aeration:

1. Aerate lawn areas two times during maintenance period, at times of year determined by the Horticultural Consultant.
2. Use a piston-driven type aerifier with 4-inch long by 1/2-inch diameter hollow tines.
3. Moisten soil to 6-inch depth a few days prior to aeration to help achieve full depth penetration with the tines.
4. Remove cores from the lawn surface and dispose of cores.

G. Dethatching: Verticut lawn areas to remove excessive thatch to a maximum 1/4-inch below soil surface when directed by Horticultural Consultant in Spring at grass green-up.

3.6 FLOWERING AND GRASS MEADOW

A. Watering:

1. Using a soil sampling tube, tensiometers and soil probe, check for moisture penetration throughout the root zone at least twice a week.
2. Water meadow areas at such frequency as weather conditions require, to replenish soil moisture to 6 inches below root zone.
3. Do not allow plant root balls to dry out.
4. Water at night if irrigation system is electrically controlled, otherwise, water during early mornings.

B. Weed Control:

1. As a last resort, control noxious or aggressive weeds, such as Bermuda Grass, Kikuya Grass, with least toxic herbicides.
2. Apply post-emerge herbicide for control of noxious weeds.
3. Coordinate application of herbicides with reseeding schedule.
4. Do not apply herbicide unless directed by the Horticultural Consultant.
5. When applying any weed control, follow all label instructions for rates and application instructions. Do not apply against label.

C. Meadow Establishment Mowing:

1. Mow entire surface of meadow areas every 4 weeks until established and 4 times per year to a height of 4 to 6 inches only when directed by the Horticultural Consultant.
2. Trim edges along paving with the lawn edger 21 times per year when required for neat appearance.
3. Grass clippings shall be removed from site unless directed otherwise by Horticultural Consultant.

D. Mowing and Edging Upon Meadow Establishment: Mow to height of 4 inches September through October.

E. Fertilizer Application:

1. Uniformly apply 16-6-8 at the rate of 5 pounds of actual nitrogen per 1,000 per square feet every 4 weeks until establishment of full coverage.
2. Meet requirements of fertilizer manufacturer’s current printed instructions.
3. Apply fertilizers evenly over planting areas by spreading half the fertilizer in one direction and half in a direction 90 degrees to the first direction to assure even application.
4. Apply dry fertilizers with a gravity or a broadcast centrifugal spreader.
5. Apply liquid fertilizers with a metered sprayer.
6. Water planting areas thoroughly after fertilizer application.

F. Reseeding of Meadow Areas: Replace, at no additional cost to the Owner, and as soon as weather conditions permit, seed meadow areas not in a vigorous, thriving condition, during and at the end of the maintenance period, except at areas affected by too much shade.

3.7 INSECTS, PESTS, AND DISEASE CONTROL

A. General:

1. Employ principles of IPM in the selection of preventative and control measures for plant pests and diseases.
2. Insignificant pests will be tolerated providing they do not seriously threaten planting health and appearance unless directed otherwise by the Horticultural Consultant.
3. Monitor the site closely and take timely action to address problems identified.
4. Use personnel licensed and experienced using materials approved by the EPA and conform to applicable laws, codes and regulations, under the direction of a licensed certified pest control operator.
5. When necessary apply the least toxic chemical required for the existing problem, unless directed otherwise by the Horticultural Consultant.
6. Apply sprays only if a pest or disease is a serious threat and cease application after problem is under control, unless directed otherwise by the Horticultural Consultant.
7. Spray with extreme care to avoid hazards to any person, pet, or automobile in the area or adjacent areas.
8. Meet requirements of chemical manufacturer's current printed label and application instructions.
9. The Contractor shall be held liable for plant damage due to the use of chemicals.

B. Plant Condition Inspection:

1. Inspect plant material daily for damage and signs of stress, pests, and disease.
2. Submit a written and photographic inspection report of observed damage, and signs of stress, pests, or disease via e-mail to the Owner, the Landscape Architect, and Horticultural Consultant within 2 days of observations.
3. Use a digital camera with at least 5.0 megapixels of resolution to document observations.

C. Spraying:

1. When necessary apply the least toxic chemical required for the existing problem.
2. Meet requirements of manufacturer's current printed instructions.
3. Apply sprays only if a pest or disease is a serious threat and cease application after problem is under control.
4. Make spray applications in early morning hours, prior to 7:00 a.m., unless approved otherwise by Owner and Horticultural Consultant.

D. Treating Existing Trees with Insecticides:

1. Aphids: Treat with merit, triact, mavrik, tempo, talstar or marathon when present.
2. Bagworms: Treat with merit, tempo, talstar, mavrik or bacillus thuringiensis when present.
3. Borers: Treat when borers are present. Spray the trunks and upper branches with merit, talstar or marathon. Open wounds are easily susceptible to borer attack.
4. Caterpillar: Treat with merit, tempo, talstar, mavrik or bacillus thuringiensis when present.
5. Galls: Treat as leaves first start to come out in the early spring with horticultural oil or with a combination spray of horticultural oil and merit, talstar or marathon.

6. Grasshoppers: Treat when present with merit, talstar, tempo or marathon.
7. Lace Bugs: Treat when present with merit, tempo or marathon.
8. Leaf Miners: Treat when present with merit, talstar, avid, marathon or tempo.
9. Scale: Treat when present with horticultural oil or a combination of merit, triact, talstar or marathon and oil. Follow the temperature restrictions for use of oil.
10. Thrips: Treat when present with merit, avid, talstar or marathon.
11. Twig Girdlers: Treat when present with merit, talstar or tempo.
12. Leaf Skeletonizer: Treat when present with talstar, merit, tempo or mavrik.

E. Treating Flowering and Grass Meadow Areas with Insecticides: Use IPM approach and spray only when thresholds could cause damage and as directed by Horticultural Consultant.

F. Preventative Treatment for Insects and Mites: Spray trees, shrubs, and ground cover once during winter months with an application of dormant oil in combination with Talstar, making sure to thoroughly cover trunks, branches, and leaves, including the underside of leaves.

G. Treating Existing Trees with Fungicides:

1. Powdery Mildew: Treat when present with clearys 3336, heritage, OHP 6672, compass, triact 70, banner, funginex, bayleton or rubigan.
2. Rust: Treat when present with heritage, banner, clearys 3336, OHP 6672, triact 70, bayleton, manzate 200 or dithane M-45.
3. Leaf Spot: Treat when present between May and September with medallion, heritage, banner, clearys 3336, OHP 6672, compass, triact 70, sextant, daconil 2787, manzate 200, dithane M-45 or durosan.
4. Botrytis: Treat when present with medallion, clearys 3336, OHP 6672, compass, triact 70, sextant.
5. Twig Blight: Treat when present with medallion, clearys 3336, OHP 6672, triact 70, sextant.
6. Rhizoctonia: Treat when present with medallion, clearys 3336, OHP 6672, compass, sextant.
7. Fusarium: Treat when present with medallion, clearys 3336, OHP 6672, sextant.
8. Anthracnose: Treat when present with clearys 3336, OHP 6672, compass, triact 70.
9. Oak Leaf Blister: Treat with bordeaux mixture when leaves are appearing in the early spring if there was a problem with this disease the previous year.
10. Oak Wilt: Inject alamo into the root flares to prevent and control oak wilt.
11. Hypoxylon Canker: Chemical treatments would not be effective because the fungus is located within the tree.

H. Treating Meadow Areas with Fungicides: Use IPM approach and spray only when thresholds could cause damage.

I. Mite Control: Treat trees and shrubs, when mites are present, from March through October with Miticidal soap, Talstar, Dicofol, Vendex, Pentac, Mavrik, or Avid.

J. Root Disease Control: Treat root diseases on trees and shrubs with Captan, Banrot, Aliette, or Subdue 2E as recommended by the Horticultural Consultant.

K. Preliminary Chemical Application Schedule to Establish Bid Price: See Preliminary Chemical Application Schedule under Article 3.13 in this Section.

L. Final Chemical Application Schedule: As directed by the Horticultural Consultant in writing.

3.8 IRRIGATION SYSTEM

A. Damages:

1. Monitor irrigation system daily for damage.
2. Repair at no additional cost to the Owner damages to system caused by Contractor's operations.
3. Perform repairs before next irrigation cycle commences.

B. Cleaning and Monitoring the System:

1. Continually monitor (daily, including weekends and holidays) the irrigation systems to verify that they are functioning properly as designed.
2. Clean filters and strainers at least once a month and as often as necessary to keep the irrigation systems free of sand and other debris.
3. Set and continuously adjust and program automatic controller for seasonal water requirement.
4. Make program adjustments as required by changing field conditions.
5. At least once a week, daily when required, use a soil sampling tube, tensiometers and soil probe to check the rootball moisture of representative plants as well as the surrounding soil.
6. Prevent or minimize spraying on paving, windows, building walls, and other structures, by balancing the throttle control on the remote control valves and the adjustment screws on the sprinkler heads.
7. Do not allow water to atomize and drift.
8. Record in writing the daily watering times set for each remote control valve and submit log of times to Owner's Designated Representative, Landscape Architect, and Horticultural Consultant bi-monthly for record purposes.

C. Winter Months: During periods of freezing temperatures, make sure irrigation system is turned off drain and restart system as soon as temperatures go above freezing.

3.9 WOOD CHIP MULCH AREAS

A. Surface Smoothness: Smooth out finished surfaces of mulch twice monthly.

B. Weed Control:

1. Maintain areas weed-free.
2. As a last resort, control weeds with least toxic chemicals.

C. Mulch Replenishment: During the last month of the maintenance period, add mulch to settled areas to bring finished surfaces back to the levels indicated on the Drawings.

3.10 FIELD QUALITY CONTROL

A. Soil Testing to Determine Fertilization Requirements:

1. When directed by the Horticultural Consultant, take up to 10 composite soil samples from locations determined by the Horticultural Consultant in the field.
2. Send samples to same laboratory used for soil testing required by Section 02910.
3. Employ the laboratory to test for the following:
4. pH measurement in the saturation extract per USDA Handbook No. 60, Method 21.
5. Electrical conductivity of the saturation extract per USDA Handbook No. 60, Method 2.
6. Sodium absorption ratio of the saturation extract per USDA Handbook No. 60, Method 20b.
7. Determination of boron, calcium, copper, iron, magnesium, manganese, molybdenum, phosphorous, potassium, sodium, sulfur, and zinc, via the following test methods: Mehlich Number 3, Bray P1, Bray P2, Olsen P, DTPA, ammonium acetate, ammonium bicarbonate DTPA, and hot water extract from boron.
8. Analysis of saturation extract for calcium, magnesium, sodium, boron, chloride, phosphorous, nitrate, and sulfate.
9. Measurement of following trace metals by the DTPA extract: aluminum, arsenic, cadmium, chromium, cobalt, lead, lithium, nickel, selenium, silver, strontium, tin, and vanadium.
10. Presence of calcium carbonate and magnesium carbonate.
11. Estimate of soil texture per commonly used methods.
12. Estimate of organic matter content per commonly used methods.
13. Exchangeable Ammonium Cation.
14. Base Saturation.
15. Cation Exchange Capacity.
16. Carbonates Determination.
17. Soil Bulk Density.
18. Water Infiltration Rate per USDA Handbook No. 60, Method 34b.
19. At least 30 days prior to commencement of soil preparation Work, submit to the Landscape Architect and Horticultural Consultant the laboratory's written soil test report including the laboratory's soil test data; the laboratory's interpretation of nutritional deficiencies, excesses, and potential toxicities; and the laboratory's amendment recommendations.
20. The Horticultural Consultant will determine the fertilization programs based on the soil test report which may differ from the soil test report amendment recommendations.

B. Maintenance Review for Two-Year Maintenance Period Following the date of Final Completion:

1. Horticultural Consultant will review Work and prepare a written report for each site inspection and will submit the report within 24 hours via e-mail to the Contractor for immediate action to reverse problems.
2. Horticultural Consultant will inspect site 12 times per year.
3. Horticultural Consultant Inspection Reports: Shall include, but not be limited to written and photographic documentation of damage and signs of stress due to pests, disease, nutritional deficiencies, watering and any other problem.
4. Contractor Verification Report: Contractor shall document and verify corrective actions to Landscape Architect and Horticultural Consultant via e-mail within 24 hours following action.

C. Maintenance Review at End of One-Year Maintenance Period:

1. At the end of the one-year maintenance period, request the Landscape Architect and Horticultural Consultant to review Work.
2. Submit a written request at least five working days prior to the anticipated date of review.
3. If the Landscape Architect and Horticultural Consultant observe Work that fails to meet the Contract Document requirements the Contractor will receive written notification from the Owner's Designated Representative of corrective Work preventing Owner acceptance of the maintenance Work.
4. Perform corrective Work within 10 calendar days after the review.
5. Upon completion of the corrective Work, request the Landscape Architect and Horticultural Consultant to review the Work.
6. Corrective Work followed by Landscape Architect and Horticultural Consultant's review will be required until the Landscape Architect and Horticultural Consultant no longer observes Work not meeting the Contract Document requirements.

D. Owner's Acceptance of Maintenance Responsibility:

1. When it appears to the Landscape Architect and Horticultural Consultant that the maintenance Work conforms to the requirements of the Contract Documents the Contractor will receive written notification designating the day which the Owner will accept maintenance responsibility.
2. Continue maintenance of landscape Work until the date that the Owner accepts maintenance responsibility.

3.11 SCHEDULES

A. Preliminary Chemical Application Schedule to Establish a Bid Price:

Chemical Type	*Applications per Year per Plant after Installation*
Insecticide spraying:	8
Fungicide spraying:	8
Root drench:	8
Dormant oil:	1
Pre-Emerge Weed Control:	4
Post-Emerge Weed Control:	8

END OF SECTION

SECTION 32 1216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving overlay.
4. Asphalt surface treatments.
5. Pavement-marking paint.
6. Cold milling of existing hot-mix asphalt pavement.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.2 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.3 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship and other applicable requirements of the Standard Specifications for, State of California, Department of Transportation (Caltrans).

1. Highway Design Manual, latest edition.
2. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

B. American society for Testing Materials (ASTM).

C. American Association of State Highway Officials (AASHO).

D. Asphalt Institute Manual (AIM).

1. Construction Specifications for Asphalt Concrete and other plant mix Types.
2. MS-10 – Soils Manual for Design of Asphalt Pavement Structures.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Samples: For each paving fabric, 12 by 12 inches minimum.

E. Qualification Data: For manufacturer.

F. Material Certificates: For each paving material, signed by manufacturers.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.

C. Regulatory Requirements: Comply with Standard Specifications of Caltrans for asphalt paving work.

D. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

C. Traffic Control: Maintain control of vehicular and pedestrian traffic during paving operations and as required for construction activities.

D. Phasing: Where existing facilities will be occupied during construction activities, phase paving work as required to maintain adequate parking and access to the parking.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, or crushed gravel.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242 or AASHTO M 17, rock dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO MP 1, PG 70-22 .

B. Prime Coat: Asphalt emulsion prime complying with Caltrans requirements.

C. Tack Coat: ASTM D 977 , emulsified asphalt or ASTM D 2397 , cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Fog Seal: ASTM D 977 , emulsified asphalt or ASTM D 2397 , cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

E. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073 , Grade Nos. 2 or 3.

C. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

D. Joint Sealant: ASTM D 3405 , hot-applied, single-component, polymer-modified bituminous sealant.

E. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than **3**minutes.

1. Color: **As indicated**

F. Glass Beads: AASHTO M 247, Type 1.

G. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

H. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized; 4 inches high by 6 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes designed according to procedures in the SSPWC.

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515 for the following nominal, maximum aggregate sizes:

a. Base Course: Class B per Table 203-6.4.3 (A)
b. Surface Course: Class D1 per Table 203-6.4.3 (A)

B. Emulsified-Asphalt Slurry: ASTM D 3910, Type **2** consisting of emulsified asphalt, fine aggregate, and mineral fillers.

C. Base Materials: Crushed aggregate base over crushed miscellaneous base:

1. Class 2 crushed aggregate base per Article 2.00-2.2 of the SSPWC or recycled material such as Crushed Miscellaneous Base (CMB) complying with Article 2.0b-2.4 or processed miscellaneous base (PMB) complying with Section 200-2.5 of the SSPWC.
2. Sub-base material shall be suitable material approved by the University's Represntative for use as sub base material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compactedaggregate base before applying paving materials.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Spread mix at minimum temperature of 250 deg F.+
3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: **1/4 inch**

2. Surface Course: **1/8 inch**

3.8 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With a fine sand, lightly dust areas receiving excess fog seal.

3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with University's Representative.

B. Allow paving to age for 7 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal..

3.10 WHEEL STOPS

A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

1. Minimum length of dowels shall be 2'-0".

3.11 FIELD QUALITY CONTROL

A. Testing Agency: University will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to **ASTM D 979**.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 32 1216

SECTION 32 1313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Curbs and gutters.
2. Walkways.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag

1.3 SYSTEM DESCRIPTION

A. Provide portland cement and concrete pouring according to materials, workmanship and other applicable requirements of the Standard specification for Public Works Construction (SSPWC), current edition.

B. American Society for Testing Material (ASTM)

C. American Association of State Highway Transportation Officials. (AASHTO)

D. American Concrete Institute (ACI)

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Joint fillers.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

C. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.

1. Refer to Division 01 Section “Quality Requirements” for mockup requirements.
2. Obtain University’s Representative's approval of mockups before starting construction.
3. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
4. Demolish and remove approved mockups from the site when directed by University’s Representative.

5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01, Section 01600, “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves with a radius of 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

C. Epoxy-Coated Welded Wire Fabric: ASTM A 884, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615 Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A 767, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775 or ASTM A 934; with ASTM A 615. Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A 184; with ASTM A 615 Grade 60, deformed bars; assembled with clips.

H. Plain Steel Wire: ASTM A 82, as drawn.

I. Deformed-Steel Wire: ASTM A 496.

J. Epoxy-Coated-Steel Wire: ASTM A 884, Class A coated, plain.

K. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated Joint Dowel Bars: ASTM A 775; with ASTM A 615, Grade 60, plain steel bars.

M. Tie Bars: ASTM A 615, Grade 60, deformed.

N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

O. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

P. Zinc Repair Material: ASTM A 780.

2.4 BASE MATERIAL

A. Base material: Crushed aggregate base or crushed miscellaneous base:

1. Class 2 crushed aggregate base per Article 200-2.2 of the SSPWC or recycled material such as crushed miscellaneous base CMB) complying with Article 200-2.4 or processed miscellaneous base complying with Article 200-2.5 of the SSPWC.
2. Sub-base material shall be suitable material approved by the University's Representative for use as sub-base material.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, Type II.

   a. Fly Ash: ASTM C 618, Class C or F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

3. Aggregate Sizes**: 1/2 to 3/4 inch** nominal.

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

1. Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edeco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, ChemRex Inc.; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation; Finishing Aid.
p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
q. Or equal.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. Burke by Edoko; Aqua Resin Cure.
c. ChemMasters; Safe-Cure Clear.
d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Euclid Chemical Company (The); Kurez DR VOX.
g. Kaufman Products, Inc.; Thinfilm 420.

h. Lambert Corporation; Aqua Kure-Clear.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100 Clear.
k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
l. Symons Corporation; Resi-Chem Clear.
m. Tamms Industries Inc.; Horncure WB 30.
n. Unitex; Hydro Cure 309.
o. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
p. Or equal.

F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.
b. Burke by Edoco; Resin Emulsion White.
c. ChemMasters; Safe-Cure 2000.
d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
f. Euclid Chemical Company (The); Kurez VOX White Pigmented.
g. Kaufman Products, Inc.; Thinfilm 450.
h. Lambert Corporation; Aqua Kure-White.
i. L&M Construction Chemicals, Inc.; L&M Cure R-2.
j. Meadows, W. R., Inc.; 1200-White.
k. Symons Corporation; Resi-Chem White.
l. Tamms Industries, Inc.; Horncure 200-W.
m. Unitex; Hydro White.
n. Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.
o. Or equal.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers:

a. Davis Colors.
b. Scofield, L. M.Company.
c. QC Construction Products, Inc.
d. Or equal.

2. Color: As selected by University’s Representative from manufacturer's full range.

C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.8 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with FS TT-P-115, Type **II** or AASHTO M 248, Type **F.**

1. Color: **As indicated**

B. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than **3** minutes.

1. Color **As indicated**

C. Glass Beads: AASHTO M 247, Type 1.

2.9 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 12-inch minimum length.

B. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized; 4 inches high by 6 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 12-inch minimum length.

2.10 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 3000 psi.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
3. Slump Limit: 4 inches, plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 3-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size

D. Limit water-soluble, chloride-ion content in hardened concrete to **0.30** percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades, subbase, and base surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase, and base surface below concrete pavements with heavy pneumatictired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase and base in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
3. Subbase and base with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase and base surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.

3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation and expansion Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated. Form doweled expansion joints of preformed joint-filler strips at maximum spacing of 24 feet.

1. Extend joint fillers full width and depth of joint.
2. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
3. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows to match jointing of existing adjacent concrete pavement:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groove marks on concrete surfaces. Locate joints at 30 inches on center each way, unless indicated otherwise.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks. Locate joints at 30 inches on center each way, unless indicated otherwise.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint. Locate joints at 20 feet minimum to 24 feet maximum on center each way unless otherwise indicated.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

C. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

D. Do not add water to fresh concrete after testing.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

G. Screed pavement surfaces with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

I. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

J. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

K. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

L. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.10 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.11 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with University’s Representative.

B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Spread glass beads uniformly into wet pavement markings at a rate of 6 lb/gal..

3.12 WHEEL STOPS

A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes drilled or cast into wheel stops at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

1. Minimum length of dowels shall be 2’-0”

3.13 FIELD QUALITY CONTROL

A. Testing Agency: University will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39; test 1 specimen at 7 days and 2 specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to University's Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by University's Representative but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by University's Representative.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.14 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by University's Representative, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1313

SECTION 32 13 16 - DECORATIVE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes colored and natural gray retardant finish concrete paving, concrete stairs, ramps, curbs and gutter and concrete bands, headers and finish for concrete site walls.

B. Related Sections:

1. Section 03 30 00 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 03 30 00.16 "Stratified Concrete Walls" for architectural concrete walls.
3. Section 07 92 00 "Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and asphalt paving or adjacent construction.

1.3 LEED REQUIREMENTS

A. Owner has established that the project will achieve LEED Certification per the requirements outlined in Section 01 35 15.

B. Following LEED requirements are mandatory for Work included in this Section in order to achieve LEED certification.

1.4 SUBMITTALS

A. See section 01 30 00 – Administrative Requirements, for submittal procedures.

~~B. Shop Drawings: Indicate layout of joints.~~

~~C.~~B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

~~D.~~C. Product Data:

1. For each type of product indicated submit manufacturer's product data, specifications, typical installation details and other data to demonstrate compliance with the specified requirements for all manufacturer products.

2. Statement of Mix Design: Submit (3) copies of Statement of Mix Design prepared by batch plant servicing Project for each load delivered to Project. Statement of Mix Design to contain following information:

    a. Name, address, and telephone number of batch plant preparing statement of mix design.
    b. Date of mix design.
    c. Project location.
    d. Contractor requesting load delivery.
    e. Mix design number.
    f. Integral color used.
    g. Gradations for sand and aggregate.
    h. Material weights, specific gravity, and absolute volumes.
    i. Basis of testing, i.e. UBC 2605 D4 and Title 24 2604 D4.
    j. Water/cement ratio.
    k. PSI rating.
    l. Signature of testing laboratory manager.
    m. Signed stamp from registered Project structural engineer or architect LEED Submittals:

E.D. Samples for Verification: To be determined by the mock-ups.

F.E. Shop Drawings:

1. Submit shop drawings for reinforcing steel and accessories in accordance with ACI standards.
2. Paving Jointing and Pour Sequence Plan - submit three full size bond prints of each paving sheet indicating the following:

    a. Proposed layout of contraction, construction and isolation joints. Clearly delineate the three different joint types.
    b. Layout of paving types as indicated on Drawing Paving Schedule. Give overall dimensions of each paving type.
    c. Concrete pour sequence. Indicated sequence of paving pour installation.

1.5 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.

4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm and individuals trained and approved by manufacturer of decorative concrete paving systems with a minimum of fifteen consecutive years' experience. Provide written evidence to indicate successful experience in installing Intecrete or equivalent architectural concrete paving, or similar, on at least (5) projects with a combined installed square footage of at least 75,000 SF with (3) projects located within a 100 mile radius of Project site.

B. ACI Certified Personnel:

1. Concrete Flatwork Finisher:

   a. Minimum of 1,500 hours of field experience having installed at least (5) projects containing Intecrete® architectural concrete paving.
   b. Must be present during important stages of concrete production such as layout, formwork, or concrete placement and finishing.
   c. Project must have a minimum of (1) ACI certified Concrete Flatwork Finisher at important phases of production.
   d. Submit verification of current ACI certification.

2. Concrete Flatwork Technician:

   a. Minimum of (1) ACI certified Concrete Flatwork Technician able to render technical assistance on project, if requested.
   b. Submit verification of current ACI certification.

C. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

D. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

E. Source Limitations: Obtain decorative concrete paving products and each type or class of cementitious material of the same brand from same manufacturer's plant, and obtain each aggregate from single source.

F. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

G. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

H. Mockups:

1. Prepare on-site paving and stair mock-ups as follows:
   a. Prepare a minimum 8-foot square mock-up of each different paving type specified on Drawings. Label mock-ups (preferably on vertical side of mock-up) with specified paving type to facilitate mock-up review.
   b. Construct mock-ups using identical concrete mix design, products, jointing, and methods of overall workmanship that will be employed during production.
   c. Ensure that same crew preparing mock-ups will be responsible for production work.
   d. Construct mock-ups in a protected location approved by Owner. Ideally mock-ups should be located as close to production work as possible to facilitate comparison review and be located in a sunny location.
   e. Approved mock-ups will be used as standard for future production work review and assessment. Owner should be prepared to physically sign mock-up using a permanent black marker to attest Owner's approval of mock-up. Rejected mock-ups can remain on-site until removal of approved mock-ups is required.
   f. Original 6-inch or 12-inch concrete samples, if they were prepared for this project, will not be used in future production paving review once mock-ups have been approved.
   g. Owner will incur costs to redo mock-ups if Owner requires design changes during mock-up review. Contractor will incur costs to redo mock-ups if Owner rejects mock-ups due to Contractor error such as incorrect concrete mix design or unacceptable appearance.
   h. Protect approved mock-ups from damage during course of Work.
   i. Clean mock-ups prior to Final Walkthrough for Acceptance to facilitate unencumbered comparison review by Owner between approved mock-ups and production work.
   k. Remove mock-ups from site when directed by Owner.

2. Prepare site wall mock-ups as follows:
   a. Minimum 5-foot long mock-up of each specific Wall type indicated on Drawings.
   b. Construct mock-ups using products, materials and workmanship methods identical to those that will be employed during production. Workmanship to exhibit finish, jointing, and edging.
   c. Use same concrete mix that will be used during production.
   d. Ensure that same personnel that prepared mock-ups will also install production work.
   e. Construct mock-ups in a location approved by General Contractor.
   f. Approved wall mock-ups will be standard for assessment for future production work.
   g. Construct additional mock-ups at Contractor's expense if workmanship is responsible for mock-up rejection by Owner, however, Owner will incur costs to redo mock-up if Owner requests design changes during mock-up preparation.
   h. Protect approved mock-ups during course of Work.

i. Remove mock-ups from site when directed by General Contractor.

I. Preinstallation Conference: Conduct conference at Project site.

1. At least three weeks prior to ordering specified materials or the start of concrete work, Arrange a pre-installation meeting between the Contractor, Architect, Project superintendent, concrete supplier, and concrete finisher to review finishing techniques of Concrete, use of additives, application of curing compounds and coordination with other trades.

1.8 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FLAT WORK FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves of a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 FORM MATERIALS

A. Plywood:

1. Exterior grade plywood panels, non-absorptive, providing a continuous, true, and smooth surface such as medium-density overlay (MDO), Class 1, or better, with mill-applied release agent and sealed edges.

2. Form Joint Tape: Pressure-sensitive compressible foam tape.

3. Form-Release Agent: Colorless form-release agent that will not bond with concrete surface or impair subsequent treatments of those surfaces.

B. Structural:

1. #2 Construction Grade S4S Douglas Fir minimum 1-1/2-inches thick, free of warping, loose knots, cupping, checks, bows, cracks, and other imperfections that would produce objectionable defects in finished work.

2. Depth of forms to be same depth as concrete being placed.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: Grade 60 steel conforming to AS A615 and free of rust, dirt, grease or oils.

B. Steel Tie Wire: 16-gauge plain cold-drawn steel conforming to AS A1064/A1064M and free of rust, dirt, grease or oils.

C. Joint Dowel Baskets: Pre-manufactured dowel basket assembly to provide construction joint stability, eliminate tripping hazards, positive load transfer, maintain continuity of surface profile, reduce joint spalling, and reduce “checkerboard” pours, without prohibiting horizontal slab movement.

1. PD3 Basket Assembly® by PNA Construction Technologies; www.pna-inc.com.

2. PNA Square/Round Dowel Basket Assembly by PNA Construction Technologies; www.pna-inc.com

D. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

D.E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

E.F. Steel Bar Mats:

1. Grade 60 deformed steel bars assembled with clips conforming to ASTM A184 and free of rust, dirt, grease or oils.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, gray portland cement Type III or Type V. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or F. Fly Ash content not to exceed 25% total concrete weight.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S uniformly graded. Provide aggregates from a single source.

1. Maximum Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
3. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

F. Liquid Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Davis Colors.
b. Admixtures Inc.
c. Scofield, L. M. Company.
d. Solomon Colors, Inc.

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/4" inch (6 mm long.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Monofilament Fibers:
1) Grace, W. R. & Co. - Conn.; Grace MicroFiber.
2) Propex Fibermesh: Fibermix Stealth.

2.6 CURING AND SEALING MATERIALS

A. Amber, Aliphatic, Membrane-Forming Curing and Sealing Compound; manufactured for use with colored concrete.

1. Admixtures Inc; Colorfull Clear Curing Compound.

2. 1100-Clear by WR Meadows; www.wrmeadows.com.

2.7 RELATED MATERIALS

A. Fine and Coarse Aggregate: Clean, hard, and durable washed concrete sand conforming to ASTM C33. Use same fine aggregate from single source throughout duration of Project. Refer to Paving Schedule on Drawings for sizing of coarse aggregate. Some paving types may require different coarse aggregate sizes

B. Joint Fillers: ASTM D 5249, Type 2, flexible foam expansion joint in preformed strips.

1. Products: W.R. Meadows; Seal Tight Cermar.

C. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (3 to 6 mm).

1. ACC; Optimus.

2. Grace, Topcast.

2.8 JOINT MATERIALS

A. Construction Joints:
1. Steel Slip Dowels: 5/8-inch-diameter smooth steel bars, free of dirt, grease, and oils.
2. Plastic Dowel Sleeves: Encase 50 percent of each dowel in a Speed Dowel® plastic alignment sleeve to allow parallel lateral movement of each dowel.

a. Acceptable Manufacturers:
1) Speed Dowel® by Greenstreak Group; www.greenstreak.com.

2.9 CONCRETE SEALER

A. Low sheen, low VOC, penetrating sealer that exhibits superior resistance to stains, spills, and other contaminates.

B. Acceptable Manufacturers:
1. Repello® by Scofield; www.scofield.com.
2. Siloxene PD® by Prosoco; www.prosoco.com.
3. 511 Impregnator by Miracle Sealants; www.miraclesealants.com.

PART 3 - EXECUTION

3.1 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): ~~28~~3000 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
3. Slump Limit: 5 inches (125 mm). plus or minus 1 inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 5 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing and retarding admixture in concrete as required for placement and workability.

E. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. M)

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

3.2 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

3.3 SUBGRADE

1. Subgrade to meet requirements of project's Geotechnical report.
2. Water condition subgrade and compact to 90 percent relative compaction is placed over prior to placing concrete.

   a. Screed subgrade to a smooth plane.
   b. Ensure that utilities, including irrigation lines are buried and compacted.
   c. Keep subgrade damp prior to placing concrete.

3.4 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below decorative concrete work to identify soft pockets and areas of excess yielding.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.6 FORMWORK

A. General:

1. Construct forms accurately to dimensions, plumb and true to line and grade.
2. Use forms that are strong, mortar tight, braced and tied so as to maintain position and shape during placing of reinforcing and concrete.
3. Wavy surfaces and bulged walls or slab surfaces resulting from settlement or springing of formwork will be rejected.
4. Carefully verify and check forms for alignment and level as the Work proceeds.
5. Make needed adjustments or add additional bracing prior to pouring concrete.

B. Formwork Material at Exposed Surfaces: Smooth metal, resin-coated plywood, or high-density overlay plywood which will provide an ultra-smooth surface.

C. Tolerances for Exposed Concrete:

1. Top of form units shall not vary more than 1/8 inch from a 10 feet long straight edge.
2. Vertical faces shall not vary more than 1/8 inch from a 10 feet long straight edge.

D. Joints:

1. Construct forms and assemble them in such a manner so that joints occur at accepted locations.
2. Seal joints to prevent leakage and provide exposed finish surfaces free of joint marks or any indication of where the form joints occurred.

E. Corners:

1. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed to face of concrete.

2. Form exposed corners to produce square smooth, solid unbroken lines, unless indicated otherwise.

F. Other Trade Requirements:

1. Construct chases, slots and recesses as required.
2. Locate inserts, anchor plates and other items to be embedded in concrete where required, properly place and securely anchor.

G. Recesses and Openings: Provide as shown on the Drawings.

H. Prior to Pouring Concrete:

1. Thoroughly clean out forms to be used.
2. Thoroughly wet wood forms where form coatings are not used.

I. Removal of Forms:

1. Do not remove supporting forms or shoring until concrete has sufficient strength to carry its own weight and other loads upon it.
2. Remove forms only after concrete has attained at least 50% of its design compressive strength.

J. Re-use of Forms:

1. Do not reuse if there is any evidence of surface wear or tear which would impair quality of exposed finishes.
2. Store formwork and form materials in such a manner as to prevent damage or distortion.
3. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage to concrete finish.

~~.~~

~~3.0 FORMWORK~~

~~. General:~~

~~9. Construct forms accurately to dimensions, plumb and true to line and grade.~~
~~10. Use forms that are strong, mortar tight, braced and tied so as to maintain position and shape during placing of reinforcing and concrete.~~
~~11. Wavy surfaces and bulged walls or slab surfaces resulting from settlement or springing of formwork will be rejected.~~
~~12. Carefully verify and check forms for alignment and level as the Work proceeds.~~
~~13. Make needed adjustments or add additional bracing prior to pouring concrete.~~

~~.A. Formwork Material at Exposed Surfaces: Smooth metal, resin-coated plywood, or high-density overlay plywood which will provide an ultra-smooth surface.~~

.A. Tolerances for Exposed Concrete:

16.1. Top of form units shall not vary more than 1/8 inch from a 10 feet long straight edge.
17.1. Vertical faces shall not vary more than 1/8 inch from a 10 feet long straight edge.

.A. Joints:

19.1. Construct forms and assemble them in such a manner so that joints occur at accepted locations.
20.1. Seal joints to prevent leakage and provide exposed finish surfaces free of joint marks or any indication of where the form joints occurred.

.A. Corners:

22.1. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed to face of concrete.
23.1. Form exposed corners to produce square smooth, solid unbroken lines, unless indicated otherwise.

.A. Other Trade Requirements:

25.1. Construct chases, slots and recesses as required.
26.1. Locate inserts, anchor plates and other items to be embedded in concrete where required, properly place and securely anchor.

.A. Recesses and Openings: Provide as shown on the Drawings.

.A. Prior to Pouring Concrete:

29.1. Thoroughly clean out forms to be used.
30.1. Thoroughly wet wood forms where form coatings are not used.

.A. Removal of Forms:

32.1. Do not remove supporting forms or shoring until concrete has sufficient strength to carry its own weight and other loads upon it.
33.1. Remove forms only after concrete has attained at least 50% of its design compressive strength.

.A. Re-use of Forms:

35.1. Do not reuse if there is any evidence of surface wear or tear which would impair quality of exposed finishes.
36.1. Store formwork and form materials in such a manner as to prevent damage or distortion.
37.1. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage to concrete finish.

3.383.7 REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap to adjacent mats.

3.393.8 FORM TIES

A. Exposed form ties will not be visible once the concrete wall is architecturally finished, however, form ties will still be required to construct wall.

B. Internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete upon removal. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2-inches from the architectural concrete surface.

C. Form ties to have a minimum working strength when fully assembled of at least 3,000 lbs.

D. Adjust form ties in length so as to permit complete tightening of forms and of such type as to lean no metal closer than 1-inch to an exterior surface or closer than ½-inch to an interior surface.

E. Do not fit form ties with lugs, cones, washers, or other device so as to act as a spreader within forms, or for other purposes that will leave a hole or depression larger than 7/8-inch in diameter back of exposed surface of concrete.

F. Do not use wire or wood ties.

G. Coat ties that are to be pulled from walls with cup grease or other approved material to facilitate efficient removal.

H. Loosen tie rods that are to be entirely removed from walls 24 hours after concrete is poured. Remove all but a sufficient number of ties to hold forms in place.

3.403.9 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Dowelled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Expansion Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion as indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3/16-inch- (5-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

1. Perform jointing with a new diamond tip circular saw.
2. Joint Width: Per Drawings. Do not exceed 3/16-inch in width.
3. Depth of sawcuts: 1/4th depth of slab.
4. Sawcut joints in a straight line complete with no overcutting.
5. Use a hand tool to sawcut up to vertical edges such as walls, steps, curbs and columns. No over cutting into vertical surfaces will be allowed.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging tool marks on concrete surfaces.

3.413.10 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

C. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

D. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

G. Screed paving surface with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

I. Hot-Weather Placement: Comply with ACI 301 (ACI 301M)and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.423.11 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

A.K. Broom Finish:

1. Prior to brooming, provide a floated finish.
2. While the surface is still plastic, provide a uniform, broom-texture finish by pulling a fiber-bristle broom uniformly over the surface.
3. Broom sidewalk paving along street in direction 90 degrees to street curb.
4. Broom Service Area paving in direction 90 degrees to building walls.

5. Provide texture to match the accepted mock-up finish.

3.433.12 RETARDANT CONCRETE FINISH

A. Integrally Colored Concrete Finish; after final floating:

1. Retardant Finish: Roll with roller tamper and then immediately bullfloat in both directions. Immediately after initial floating, towel smooth with no indentions, apply retardant when surface has sufficient moisture in the surface.
2. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
3. Provide texture to match the accepted mock-up finish.

3.443.13 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Begin curing after finishing concrete but not before and applying retardant finish.

C. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.453.14 TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/8 inch (3 mm).
4. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
5. Vertical Alignment of Dowels: 1/4 inch (6 mm).
6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
7. Joint Spacing: 1/8 inches (3 mm).
8. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
9. Joint Width: 1/16 inches (1.5 mm).

3.46 FIELD QUALITY CONTROL

. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive strength tests equals or exceeds specified compressive strength and no compressive strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

. Decorative concrete paving will be considered defective if it does not pass tests and inspections.

. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.513.15 STAINING AND SEALING

A. Allow Stratified or Sedimentary ™ to dry sufficiently before applying specified stain or sealer.

B. Do not apply sealer if air temperatures are below 50 degree F or above 90 degrees F.

C. Once the concrete surface has been sealed, protect surface until fully dried.

D. Follow manufacturer’s directions for stain or sealer application.

3.52

3.533.16 REPAIRS AND PROTECTION

A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 16

SECTION 32 1401 – BIORETENTION SOIL MEDIA (BSM)

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

BSM should achieve a long-term, in-place infiltration rate of 5 inches per hour, according to the 2012 Standard Urban Stormwater Mitigation Plan (SUSMP) requirements.

BSM should also support plant growth while providing pollutant treatment. In order to achieve these two goals, the BSM should be a mixture of sand, fines and compost. The following composition includes the measurements for determining the BSM by volume and weight:

BSM Composition	**Sand**	**Sandy Loam**			**Compost**
		Sand	**Silt**	**Clay**	
Volume	65%	20%			15%
Weight	75-80%		10% max.	3% max.	9 % max.

1.2 SUBMITTALS

Product Data: Submit manufacturer's product data and installation instructions. Include required substrate preparation, list of materials, application rate/testing, and permeability rates.

Verifications: Manufacturer shall submit a letter of verification that the products meet or exceed all physical property, endurance, performance and packaging requirements.

Tests should be conducted no more than 180 days prior to the delivery date of the BSM to the project site. Batch-specific test results and certification will be required for projects installing more than 100 cubic yards of BSM.

The applicant should submit the following to the municipality for approval if requested.

A. A sample of mixed BSM
B. Grain size analysis results of the sand component performed in accordance with American Society for Testing and Materials (ASTM) D422. *Standard Test Method for Particle Size Analysis of Soils.*
C. Grain size analysis results of sandy loam soil component performed in accordance with ASTM D422., *Standard Test Method for Particle Size Analysis of Soils.*
D. Grain size analysis results of compost component performed in accordance with ASTM D422, *Standard Test Method for Particle Size Analysis of Soils.*
E. Organic matter content test results of compost. Organic matter content tests *Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes* or *Testing Methods for the Examination of Compost and Composting* (TMECC) 05.07A, *Loss-On-Ignition Organic Matter Method.*

F. A description of the equipment and methods used to mix the sand, sandy loam, and compost to produce BSM.
G. Constant head permeability results of the mixed BSM. Constant head permeability testing in accordance with ASTM D2434, *Standard Test Method for Permeability of Granular Soils (Constant Head)* should be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.
H. Provide the following information about the testing laboratory(ies) including:
    1) Name of laboratory(ies)
    2) Contact person(s)
    3) Address(es)
    4) Phone contact(s)
    5) Email address(es)
    6) Qualifications of laboratory (ies), including use of ASTM and U.S. Department of Agriculture (USDA) method of standards.

1.3 SAND SPECIFICATIONS FOR BSM

1.3.1 SAND QUALITY

Sand should be thoroughly washed prior to delivery and free of wood, waste, and coatings such as clay, stone dust, carbonate, or any other deleterious material. All aggregate passing the No. 200 sieve size should be non-plastic.

1.3.2 SAND TEXTURE

Sand for BSM should be analyzed by a qualified lab using #200, #100, #40, #30, #16, #8, #4, and 3/8-inch sieves (ASTM D422 or as approved by municipality) and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	Min.	Max.
3/8 inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	100
No. 30	15	70
No. 40	5	55
No. 100	0	15
No. 200	0	5

Note: all sands complying with ASTM C33, *Standard Specification for Concrete Aggregates* for fine aggregate comply with the above gradation requirements.

1.4 SANDY LOAM SOIL SPECIFICATIONS FOR BSM

1.4.1 SANDY LOAM SOIL QUALITY

Sandy loam soil for the BSM shall be free of wood, waste, coating such as stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be non-plastic.

1.4.2 SANDY LOAM SOIL TEXTURE

Sandy loam soil should comply with the following specifications by weight based on ASTM D422 (or as approved by municipality):

A. 50-74 percent sand
B. 0-48 percent silt
C. 2-15 percent clay

Note: these ranges were selected from the USDA soil textural classifications for a sandy loam, such that clay content does not exceed 15 percent of sandy loam.

1.5 COMPOST SOIL SPECIFICATIONS FOR BSM

1.5.1 COMPOST TEXTURE

A qualified lab should analyze compost using No. 200 and 1/2-inch sieves (ASTM D422 or as approved by municipality), and meet the following gradation:

	Percent Passing (by weight)	
Sieve Size	Min.	Max.
½ inch	97	100
No. 200	0	5

1.5.2 COMPOST QUALITY TESTING

Compost should be well-decomposed, stable, weed-free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials, **not including manure or biosolids**. Compost shall have a dark brown color and a soil-like odor. Compost that is exhibiting a sour or putrid smell, contains recognizable grass or leaves, or is hot (120 degrees Fahrenheit) upon delivery or rewetting is not acceptable.

Compost shall be produced at a facility inspected and regulated by the Local Enforcement Agency for CalRecycle. The past three inspection reports shall be submitted verifying testing and compliance with CalRecycle Title 14, *Process to Further Reduce Pathogens (*PFRP), and EPA 40 CFS 503.

Compost should comply with the following requirements:

Parameter	Method	Requirement	Units
Metals			
Aresenic	-	< 20	mg/kg dry weight
Cadmium		< 10	
Chromium		< 600	
Copper		< 750	
Lead		< 150	
Mercury		< 8	
Nickel		< 210	
Selenium		< 18	
Zinc		< 1400	
Pathogens			
Salmonella	-	< 3	MPN per 4 g
Fecal Coliform		< 1000	MPN per 1 g
Inert Material/Physical Contaminants			
Plastic, Metal and Glass	-	< 1%	by weight
Sharps (% > 4mm)		0%	by weight

1.5.3 ALTERNATIVE ORGANIC AMENDMENTS

Alternative organic amendments (in lieu of previously defined compost) will be reviewed on a case-by-case basis. Organic amendments should make up no more than 5 percent of the BSM bulk volume, unless organic alternatives comply with the specifications of section G.1.5.2.

1.6 BSM SPECIFICATIONS

BSM shall be free of roots, clods stones larger than 1-inch in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush, and other litter. It shall not be infested with nematodes or undesirable disease-causing organisms such as insects and plant pathogens. BSM shall be friable and have sufficient structure in order to give good aeration to the soil. The following specifications should govern the bulk BSM.

1.6.1 BSM TEXTURE

Gradation Limit: The definition of the soil should be the following USDA classification scheme by weight:

A. Sand: 85-90 percent

B. Silt: 10 percent maximum

C. Clay: 5 percent maximum

Compost should compose no more than 9 percent of the bulk BSM weight and should primarily fall into the sand component above (per section G.1.5.1 compost gradation limits)

1.6.2 BSM QUALITY TESTING

In addition to the compost quality testing requirements outlined in section G.1.5.2, the final BSM should meet the following standards. Testing results from the following specifications shall be submitted for approval prior to BSM acceptance.

Parameter	Method	Requirement	Units
Organic Matter	Loss of Ignition	2%-5%	dry weight
pH	Saturation Paste	6.0-8.0	-
Carbon: Nitrogen Ration	-	10:1-20:1	-
Cation Exchange Capacity(CEC)	-	≥ 5	meq/100 g of dry soil
Salinity (Electrical Conductivity)	Saturation Extract	0.5-3	dS/m
Boron	Saturation Extract	< 2.5	
Chloride	Saturation Extract	< 150	
Sodium Adsorption Rate (SAR)	-	< 3	
Extractable Nutrients			
Phosphorous	Ammonium Bicarbonate/DPTA extraction method	< 15	mg/kg dry weight
Potassium		100-200	
Iron		24-35	
Manganese		0.6-6.0	
Zinc		1.0-8.0	
Copper		0.3-5.0	
Magnesium		50-150	
Sodium		0-100	
Sulfur		25-500	
Molybdenum		0.1-2.0	
Aluminum		< 3.0	

PART 2 – SUBSURFACE BASE

2.1 DECORATIVE ROCK

Top rock layer of the bioretention basin shall be per Landscape plans. Provide 2 inch hardened permeable material as directed by landscape architect to avoid erosion by harsh velocity. Rock layer may consist of a combination of rock, tile, and rooted plants.

2.2 CLASS II PERMEABLE BASE

Permeable base course shall only be used as specified on plans. Refer to CA Department of Transportation Standard Specifications, Division VII, Section 68 for further requirements.

A. Permeable material for use in backfilling trenches under, around, and over underdrains must consist of hard, durable, clean sand, gravel, or crushed stone and must be free from organic material, clay balls, or other deleterious substances. Permeable material must have a durability index of not less than 40.
B. Class 2 permeable material must have a sand equivalent value of not less than 75.

C. The percentage composition by weight of Class 2 permeable material in place must comply with the gradation requirements shown in the following table:

Sieve Size	Percentage Passing
1”	100
3/4”	90-100
3/8”	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

2.3 GRAVEL ABOVE AND BELOW PIPE

Rock surrounding subsurface drains shall conform to AASHTO requirements for No. 57 Grading. The percentage composition by weight of rock material in place must comply with the gradation requirements shown in the following table:

Sieve Size	Percentage Passing
1.5”	100
1”	95-100
1/2"	25-60
No. 4	0-10
No. 8	0-5

PART 3 - INSTALLATION OF BSM

The following section provides consideration for proper BSM installation.

3.1 CONSIDERATIONS PRIOR TO BSM INSTALLATION

The following questions and guidelines should be discussed with the contractor prior to installing the BSM at the project site to prevent any confusion and errors.

A. Ensure that the contractor is familiar with constructing bioretention systems.
B. Plan how inspections will be handled as part of the construction process.
C. Verify BSM meets specification prior to delivery and placement in the facility.
D. Prevent over-compaction of native soils in areas of the basin where infiltration will occur. Delineate the facility area, and keep construction traffic off. Protect soils with fencing, plywood, etc.
E. Provide erosion control in the contributing drainage areas of the facility. Stabilize upslope areas.

F. Drainage should be directed away from bioretention facilities until upslope areas are stabilized. The concentration of fines could prevent post-construction infiltration and cause design failure.
G. If drainage is to be allowed through the facility during construction, leave and backfill at least 6 inches above the final grade. Temporarily cover the underdrain with plastic or fabric. Line or mulch the facility.
H. Bioretention facilities should remain outside the limit of disturbance to prevent soil compaction by heavy equipment. Protect bioretention areas with silt fence or construction fencing.
I. Verify installation of underdrain is correct prior to placing soil.

3.2 BSM MIXING AND PLACEMENT

These guidelines should be followed to ensure proper BSM mixing and placement:

A. Erosion and sediment control practices during construction should be employed to protect the long-term functionality of the bioretention. The following practices shall be followed for this reason:
    1) Provide erosion control in the contributing drainage areas to the facility and stabilize upslope areas.
    2) Facilities should not be used as sediment control facilities, unless installation of all bioretention-related materials are withheld towards the end of construction, allowing the temporary use of the location as a sediment control facility, and appropriate excavation of sediment is provided prior to installation of bioretention materials.
B. Do not excavate, place soils, or amend soils during wet or saturated conditions.
C. Operate equipment adjacent to the facility. Equipment operation within the facility should be avoided to prevent soil compaction. If machinery must operate in the facility, use lightweight, low ground-contact pressure equipment.
D. If constructing an infiltrating facility, the subgrade should be ripped or scarified to a minimum depth of 9 inches on 3-foot centers to promote greater infiltration.
E. Consider the time of year and site working area when determining whether to mix BSM on-site or to import pre-mixed soil. It is recommended that the BSM should be mixed prior to being delivered to the site, and mixing is not allowed on-site during rainy season. If BSM mixing occurs on-site during the dry season, use an adjacent impervious area or mix BSM on plastic sheeting. (Mixing should not occur within the bioretention basin.)
F. Place soil in 6- to 12-inch lifts with machinery adjacent to the facility (to ensure equipment is not driven across soil). If working within the facility, to avoid over-compacting, place first lifts at far end from entrance and place backwards towards entrance.
G. Allow BSM lifts to settle naturally, lightly water to provide settlement and natural compaction between lifts. After lightly watering, allow soil to dry between lifts. Soil cannot be worked when saturated, so this method should be used with caution to ensure dry conditions. After all lifts are placed, wait a few days to check for settlement, and add additional media as needed. No mechanical compaction is allowed.
H. The long-term hydraulic conductivity rate should not be less than 5 inches per hour when tested with a double ring infiltrometer (in accordance with ASTM D3385, *Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer)*, a single ring infiltrometer, a Modified Philip-Dunne Infiltrometer, or other approved methods.

I. Vehicular traffic and construction equipment shall not drive on, move onto, or disturb the BSM once placed and water-compacted.
J. Rake bioretention soil as needed to level out. Verify BSM elevations before applying mulch or installing plants.

Other Considerations:

- Protect adjacent infiltration systems including swales, soils, and porous pavement from sediment.
- Protect adjacent trees.

3.3 MULCH AND BIORETENTION FACILITIES

A 2-inch layer of aged mulch shall be installed on the surface of the bioretention soil for planting of container stock and if no hydroseeding is to be installed.

Aged mulch reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. Aged mulch can be obtained through soil suppliers or directly from commercial recycling yards. Apply 2 inches of well-aged shredded hardwood mulch once a year, preferably in June, after and weeding.

Compared to green wood chip or bark mulch, aged mulch has less of a tendency to float into overflow inlets during intense storms. Bark or wood chip mulch may be used on the side slopes of basins above the maximum water line. The project landscape architect may also specify another type of **non-floating** mulch, subject to approval by the local jurisdiction. Composted mulch should be avoided due to its potential to contribute pathogens and nutrients to the bioretention facility.

If hydroseeding is to be installed on the surface of the bioretention soil, no stabilized matrix shall be used in the hydroseed components or mix.

SECTION 32 1402 – PERMEABLE INTERLOCKING CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 DEFINITIONS

Bundle: Several paver layers packaged together.

Paver layer: Concrete pavers manufactured into patterned layers and ready for mechanical installation.

Mechanical installation: Using a machine to lift and install paving layers.

Laying face: Exposed, vertical face of a row of concrete pavers complete in place.

1.2 SUBMITTALS

For jointing and bedding aggregates submit:

1. Gradation under California Test 202
2. Crushed particle under California Test 205
3. Abrasion loss under California Test 211
4. Cleanness value under California Test 227

For pavers submit:

1. Four manufactured, representative full-size samples of each type, thickness, finish, and color
2. Laboratory test reports indicating compliance with ASTM C 936

Submit PICP installation crew qualifications.

1.3 TEST PANELS

The Contracting officer uses authorized test panels as the standard when evaluating the texture and color of the PICP surface.

As a first order of work, construct and test panels at the jobsite. Use the materials, tools, equipment, personnel, and methods you will use in the work. Construct at least 2 test panels. Test panels must meet the requirements for surface finish, thickness, and joints.

Test panels must be:

1. Constructed at an authorized location
2. At least 10 by 10 ft if the pavers are installed manually

If the Engineer rejects the test panels, construct new test panels.

Obtain authorization of the test panels before placing other PICP.

Remove and dispose of rejected test panels. Authorized test panels must remain in place until all PICP is completed. If authorized test panels are not constructed within the limits shown for PICP, remove and dispose of them.

1.4 AGGREGATE

At least once per project, test aggregate as shown in the following table:

Test	Test method
Sieve analysis	CT 202
Percent of crushed particles, course aggregate, 2 fractured faces, percent minimum	CT 205
Los Angeles Rattler, loss at 500 revolutions, percent maximum	CT 211
Cleanness value	CT 227

1.5 SURFACE INFILTRATION TESTING

Test the completed PICP surface under ASTM C1701. For each area of 25,000 sf, perform 3 tests. For each additional area of 10,000 sf or less, perform 1 test. Each test location must be separated by at least 20 ft. Do not perform tests (1) if there is standing water on the pavement surface or (2) less than 24 hours after 1/4 inch or more of rain. The infiltration rate must be at least 100 inches/hour.

PART 2 – MATERIALS

2.1 GENERAL

The aggregate for bedding and jointing must be graded within the limits shown in the following table:

Sieve size	Percentage passing		
	No. 8	No. 89	No. 9
1/2 inch	100	100	100
3/8 inch	85–100	90–100	100
No. 4	10–30	20–55	85–100
No. 8	0–10	5–30	10–40
No. 16	0–5	0–10	0–10
No. 50	--	0–5	0–5

If the joints between manufactured units are 1/4 inch wide or less, use no. 89 or no. 9 aggregate.

At least 95 percent of the aggregate particles must have at least 2 fractured faces.

The abrasion loss of the aggregate must not exceed 40 percent.

The cleanness value of the aggregate must be at least 80.

2.2 PAVERS

Pavers must comply with ASTM C 936 except the requirements for resistance to freezing and thawing do not apply.

Pavers must be at least 3-1/8 inch thick.

PART 3 – CONSTRUCTION

3.1 SUBGRADE AND BEDDING

Immediately before placing bedding, the subgrade must be

1. Compacted and graded as specified
2. Free of loose and extraneous material
3. Free of standing or flowing water
4. Consists or small-sized, open-graded angular aggregate, ASTM No. 8 stone or similar sized material.

Moisten, spread, and screed the bedding over the subgrade. Test the screeded surface for smoothness with a 12-foot straightedge. The surface must be within 0.03 ft of the straightedge's lower edge.

Keep all vehicles off the screeded surface. If you disturb the subgrade, recompact and regrade. If you disturb the screeded surface, screed the surface and retest for smoothness with the straightedge.

3.2 PAVERS AND JOINTING AGGREGATE

Install pavers in the pattern shown. Maintain straight pattern lines.

Fill gaps at the edges of the PICP area with cut pavers. Cut pavers must be at least one-third of a whole paver. Use a masonry saw to cut the pavers.

Fill the joints with dry jointing aggregate by sweeping. Remove excess aggregate by sweeping.

Compact jointing aggregate and seat the pavers into the bedding course using a low-amplitude, 75-90 Hz plate compactor capable of at least 5,000 lbf. Make two passes across the PICP with the plate compactor. Do not compact within 6 ft of the unconfined edges of the PICP. Remove and replace any cracked pavers.

Apply additional jointing aggregate and fill within 1/4-inch of the top of the pavers. Remove excess aggregate by sweeping.

For each day of paving, fill joints, seat pavers, and apply additional jointing aggregate to within 6 ft of the laying face.

Test the PICP surface for smoothness with a 12-foot straightedge. The surface must be within 0.03 ft of the straightedge's lower edge.

Joints formed along the bond lines of the paver pattern must be straight. Joints must not deviate more than 0.04 ft. from a straight line. Measure the joint deviation from a 50-ft string line pulled over contiguous joint lines.

The surface elevation of the PICP must be 0.03 to 0.04 ft above adjacent drainage inlets, concrete collars, or channels.

Protect PICP from sediment deposition and damage due to subsequent construction activity on the site.

At least 14 days after placement of PICP, adjust the PICP by applying additional jointing aggregate to within 1/4-inch of the top of the pavers. Remove excess aggregate by sweeping.

3.3 PRE-CONSTRUCTION MEETING

For commercial and municipal projects, the specifications should include a preconstruction meeting. The pre-construction meeting is held to discuss methods of accomplishing all phases of the construction operation, contingency planning, and standards of workmanship. The general contractor typically provides the meeting facility, meeting date and time. Representatives from the following entities should be present;

1. “General” Contractor superintendent.
2. PICP subcontractor foreman.
3. Concrete paving unit manufacturer’s representative.
4. Testing laboratory(ies) representative(s).
5. Engineer or owner’s representative.
6. Other affected trades or representatives who will access PICP area.

The following items should be discussed and determined:

1. Test panel (mock-up) location and dimensions.
2. Methods for keeping all materials free from sediment during storage, placement, and on completed areas.
3. Methods for checking slopes, surface tolerances, and elevations.
4. Concrete paving unit delivery method(s), timing, storage location(s) on the site, staging, paving start point(s) and direction(s).
5. Anticipated daily paving production and actual record.
6. Diagrams of paving laying/layer pattern and joining layers as indicated on the drawings
7. Monitoring/verifying paver dimensional tolerances in the manufacturing facility and on-site if the concrete paving units are mechanically installed.
8. Testing intervals for sieve analyses of aggregates and for the concrete paving units.
9. Method(s) for tagging and numbering concrete unit paving packages delivered to the site.
10. Testing lab location, test methods, report delivery, contents and timing.
11. Engineer inspection intervals and procedures for correcting work that does not conform to the project specifications.
12. Procedure for testing and approval of subgrade, subbase and base.

13. Curb type and installation schedule.

3.4 PLAN SITE ACCESS AND KEEPING PICP MATERIALS FREE FROM SEDIMENT

Preventing and diverting sediment from entering the aggregates and pavement surface during construction must be the highest priority. Extra care must be applied to keeping sediment completely away from aggregates stored on site as well as the PICP. In some cases, it may be necessary to construct PICP before other soil-disturbing construction is completed. The options below are for ensuring that the PICP does not become contaminated with sediment from construction vehicles. The options below are in ascending cost order. One or more of these options should be decided in the project planning stages and included in the specifications and drawings.

1. Install the PICP first and allow construction traffic to use the finished PICP surface. When construction traffic has ceased and adjacent soils are stabilized with vegetation or erosion control mats, clean the PICP surface and joints with a vacuum machine capable of removing an inch (25 mm) of the stone from the joints. Vacuum a test area and inspect the joints when stone is removed to be sure there are no visible traces of sediment on the stone remaining in the joints. If it is visible, then vacuum out jointing stones until no sediment is present. Fill the joints with clean stones and sweep the PICP surface clean.

2. Protect finished PICP system by covering the surface with a woven geotextile and a minimum 2 in. thick No. 8 open-graded aggregate layer. This aggregate layer and geotextile are removed upon project completion and when adjacent soils are stabilized with vegetation or erosion control mats. The PICP surface is swept clean.

3. Construct the aggregate subbase and base and protect the surface of the base aggregate with geotextile and an additional 2 in. (50 mm) thick layer of the same base aggregate over the geotextile. Thicken this layer at transitions to match elevations of adjacent pavement surfaces subject to vehicular traffic. A similar more costly approach can be taken using a temporary asphalt wearing course rather than the additional base aggregate and geotextile. When construction traffic has ceased and adjacent soils are vegetated or stabilized with erosion control mats, remove geotextile and soiled aggregate (or the asphalt) and install the remainder of the PICP system per the project specifications.

4. Establish temporary road or roads for site access that do not allow construction vehicle traffic to ride over and contaminate the PICP base materials and/ or surface with mud and sediment. Other trades on the jobsite need to be informed on using temporary road(s) and staying off the PICP. The temporary road is removed upon completion of construction and opening of the PICP surface to traffic.

5. A washing station for the truck ties may be deemed necessary by the contracting officer.

6 in. (150 mm) of the final bottom elevation. This area can contain water during storms over the construction period and exit via temporary drain pipes. Heavy equipment should be kept from this area to prevent compaction. If equipment needs to traverse the bottom of the excavation, tracked

vehicles can reduce the risk of soil compaction. As the project progresses, sediment and the remaining soil depth can be excavated to the final grade immediately before installing the aggregate subbase and base. Depending on the project design, this technique might eliminate the need for a separate sediment basin during construction.

3.5 AVOID SOIL COMPACTION UNLESS REQUIRED IN THE PLANS AND SPECIFICATIONS

If compaction is not specified, the initial undisturbed soil infiltration should be carefully maintained during excavation and construction as this will enable the base to drain as designed. If the soil is inadvertently compacted by equipment during construction, there will be substantial loss of infiltration. A loss may be acceptable if the infiltration rate of the soil when compacted was initially considered during design and in drainage calculations. Compacted soil can be remedied by scarifying to increase its infiltration. This is done by back-dragging loader bucket teeth across the soil prior to placing the aggregate subbase. This loose layer will receive subbase or base aggregate compacted into it to reduce the risk of surface settlement.

3.6 INSTALL GEOTEXTILES, IMPERMEABLE LINERS AND DRAIN PIPES IF REQUIRED IN THE PLANS AND SPECIFICATIONS

Geotextiles are used in some permeable pavement applications per the design engineer. If there are no concrete curbs and soil is restraining the sides of the base/subbase at its perimeter, then geotextile should be applied to prevent lateral migration of soil into the base/subbase aggregates. Geotextile is applied vertically against the soil with at least 1 ft (0.3 m) extending horizontally under the subbase and resting on the soil subgrade. A minimum 1 ft (0.3 m) overlap is recommended in stronger subgrade soils and 2 ft (0.6 m) overlap on poor-draining weaker soils (CBR<5%). When specified, impermeable liners require assembly per the manufacturer’s instructions at the shop or job site. Once assembled, they should be tested for leaks with special attention to seams and pipe penetrations. Drain pipes are installed according to plans and specifications and should be rigid PVC. Designs should have curb cutouts or drain pipes from the PICP entering swales or storm sewer catch basins to handle overflow conditions. A minimum of 12 in. (300 mm) aggregate cover is recommended over drainpipes to protect them from damage during subbase or base compaction. If there is a risk of drain pipe damage, consider using a heavy gauge pipe or test the pipe and base in a trial area with compaction equipment prior to placing and compacting a large area. Perforations in pipes should terminate 1 ft (0.3 m) short of the sides of the opening for the base. When corrugated metal drain pipes are used, they should be aluminized, and aluminized pipe in contact with concrete should be coated to prevent corrosion. Perforated drain pipes should have caps fastened to the upslope ends. Daylighted drain pipes require wire mesh over the openings to keep out debris and animals.

3.7 OBSERVATION WELLS

A 4 to 6 in. (100 to 150 mm) diameter vertical perforated pipe that serves as an observation well may be specified in PICP subject to vehicular traffic. The pipe should be kept vertical during filling of the excavated area with open-graded aggregate and during compaction. The bottom of the pipe can be forced into the soil subgrade and held in place during base/subbase filling and compaction. The pipe should be

located in the lowest elevation and a minimum of 3 ft (1 m) from the PICP side. Figures 12, 13 and 14 illustrate a well accessible from the surface and another with the pipe under the pavers to prevent damage from vandals.

3.8 PLACE AND COMPACT THE AGGREGATE SUBBASE

ASTM No. 2 subbase material should be spread in minimum 6 in. (150 mm) lifts. Compaction is typically done with a 10 ton (9 T) steel vibratory roller or a 13,500 lbf (60 kN) plate compactor. Greater lift thicknesses are normal (i.e., 12 in. or 0.3 m) when using either of these compactors. When using a roller, the first two passes are in vibratory mode and the last two are in static mode. Compaction is completed when no visible movement can be seen in the base when rolled by the compactor. Figure 15 illustrates a vibratory roller compacted No. 2 stone subbase. Plate compactors with a minimum compaction force of 13,500 lbf (60 kN) with compaction indicators should be used to determine when compaction is completed. Plate compactors are needed to compact in corners and edges where roller compactors are not effective. Aggregates should not be crushed by the compactor. Surface tolerance of the compacted ASTM #2 shall be +/- 21/2 in. (65 mm) over a 10 ft. (3 m) straightedge.

3.9 INSTALL CURBS OR OTHER EDGE RESTRAINTS

The selection of edge restraints depends on whether the PICP is for pedestrian, residential driveway or vehicular use. Table 1 summarizes recommended by edge restraint type based on the application. Cast-in-place concrete, precast concrete and cut stone curbs are typically a minimum of 9 in. (225 mm) high and rest on the compacted No. 2 stone subbase. Consideration should be given to installing a concrete haunch under precast concrete or stone curbs. Curbs may be higher than 9 in, (225 mm) if they hold back grass, a sidewalk, bioswale or other structure. Figure 6 illustrates typical curb cross-section. If PICP is adjacent to existing impervious asphalt or concrete pavement, curbs level with the permeable and impervious surfaces are used. The curb should extend the full depth of the base under the impermeable pavement to protect its base from becoming weakened from excessive water. Another option is to separate the two bases with an impermeable liner. Figure 7 shows a concrete curb between impervious pavement and PICP base and subbase. The risk of water weakening the base under the impervious pavement can be substantially decreased by sloping the soil subgrade under the PICP away from the impervious pavement base and by using perforated drain pipes to remove water before it can collect next to the base supporting the impervious pavement. Curbs installed against existing impervious pavement and base may cause erosion and weakening of the base from excavation due to installing the PICP. Eroded spaces can be filled with concrete to support the asphalt or concrete surface and base next to the curb. For pedestrian areas and residential driveways, an edge restraint option is using compacted, dense graded berms around PICP base perimeter with plastic or metal edging fastened to their surface. The dense-graded base is a foundation for metal or plastic edging secured with steel spikes. These edge restraints are installed on the dense-graded berms in a manner identical to those on interlocking concrete pavement driveways. Figure 16 shows a typical cross-section of this construction and Figure 17 illustrates the berms in place prior to filling the driveway with open-graded aggregate. Figure 18 shows compaction of both types of bases. Figure 19 shows the pavers in place against a plastic edge restraint spiked or nailed into the dense-graded base. The edge restraint contains some of the bedding layer such that at least the bottom half of the pavers is also contained by the edging. Figure 20 illustrates a concrete toe placed against a sidewalk behind a driveway with a cast-in-place concrete edge. Concrete toes rest on the base extending at least 6 in. (150

mm) past the paver edges. The concrete should be a minimum of 4 in. (100 mm) wide by 3 in. (75 mm) deep so that it can restrain the pavers. Concrete mixed on the job site should use an approximate 5:1 aggregate to cement content. Once prepared in a concrete mixer, the concrete toe is typically spread with a shovel and smoothed with trowel. Pavers are compacted once the concrete has hardened. This type of edging is not recommended in cold climate regions because of the high risk of cracking.

3.10 PLACE AND COMPACT THE AGGREGATE BASE

The ASTM No. 57 base layer is spread and compacted as one 4 in. (100 mm) lift. Like the subbase aggregate, the initial passes with the roller can be with vibration to consolidate the base material as shown in Figure 21. A 13,500 lbf (60 kN) plate compactor (Figure 22) also can be used to compact the No. 57 base layer. Surface tolerance of the compacted No. 57 stone shall be +/- 3/4 in. (19 mm) over a 10 ft. (3 m) straightedge. Equipment drivers should avoid rapid acceleration, hard braking, or sharp turning when driving on the compacted No. 2 subbase and on the No. 57 base. Tracked equipment is recommended. If the subbase or base surfaces are disturbed, they should be re-leveled and re-compacted. A test section of the subbase and base should be constructed initially for compaction monitoring. The section will indicate settlement of the pavement section, and be used to monitor and prevent crushing of the aggregate. The area should be used to train inexperienced construction personnel on compaction techniques. Some designers prefer field measurement of subbase and base densities after compaction. If nuclear density gauge testing is desired, it cannot effectively be done on the No. 2 subbase. However, density testing can be done in backscatter mode on the No. 57 base layer). The guide construction specification includes a compaction testing method for the No. 57 base layer. The purpose of this test method is to attain consistent density. Besides nuclear density gauges, (nonnuclear) stiffness gauges may also be used to assess compacted base density.

3.11 PLACE AND SCREED THE BEDDING LAYER

When subbase and base lifts are compacted the surface should then be topped with a 2 in. (50 mm) thick layer of No. 8 crushed stone bedding layer. This layer is screeded and leveled over the No. 57 base. Metal rails are placed on the compacted No. 57 layer and are used to guide screeding elevations. Various sizes of screeding equipment can be used ranging from hand tools, bucket screeds powered manually or by machine, or a modified asphalt spreader that uses a laser guidance system to maintain elevations. Figure 25 and 26 illustrate examples of screeding equipment. A moist bedding layer facilitates screeding. The surface tolerance of the screeded No. 8 bedding material should be ±3/8 in. over 10 ft. (±10 mm over 3 m). The concrete pavers should be placed immediately after the No. 8 stone bedding is placed and screeded. Construction equipment and foot traffic should be kept off the screeded layer.

3.12 INSTALL THE PAVERS MANUALLY OR WITH MECHANICAL INSTALLATION EQUIPMENT

After screeding the bedding material, the pavers are placed on this layer. Paver installation can be by hand or with mechanical equipment. Mechanized installation may be a cost-efficient means to install the units and reduce installation time. Figure 27 and 28 shows mechanized equipment placing permeable paver layers manufactured for placement in their final laying pattern. Mechanical installation requires careful

planning including selection available paver layer patterns from local manufacturers and well-orchestrated material flow logistics in order to gain efficiencies. For further information on mechanical installation, consult *ICPI Tech Spec 11—Mechanical Installation of Interlocking Concrete Pavements* and *ICPI Tech Spec 15—A Guide for the Construction of Mechanically Installed Interlocking Concrete Pavements*. An important consideration on large mechanical installation projects is monitoring paver production mold wear. *Tech Spec 15* covers managing dimensional growth of pavers and provides means for confirming dimensions of the pavers at the factory and on the job site. Managing paver dimensions should be decided between the paver manufacturer and paver installation contractor and confirmed at the preconstruction meeting. Border courses consisting of mostly whole (uncut) pavers are typically used against curbs at PICP edges and at transitions to other pavement surfaces. Paving units abutting border courses should be cut to fill spaces prior to compaction. Cuts should provide gaps around the entire perimeter of the stone that are consistent with the typical joint size—this will allow for proper interlock between units and prevent direct paver on paver contact. Cut units should be no smaller than one-third of a whole unit if subject to vehicular traffic. All installed units should have joints filled and compacted within 6 ft (2 m) of the laying face at the end of each day.

3.13 FILLING THE PAVER JOINTS AND SWEEP THE SURFACE CLEAN

The paver joints are filled with ASTM No. 8, 89 or 9 stone. Depending on the PICP area, spreading and sweeping can be done with shovels and brooms, or larger areas with machines and swept into the paver joints with powered brooms or sweepers. Once the joints are full (within 1/4 in. or 6 mm of the paver surface), the surface must be swept clean prior to compaction as loose stones on the surface can mar the pavers when in contact with a plate compactor. Figure 29 illustrates various filling and sweeping methods.

3.14 COMPACT THE PAVERS

After the PICP surface is swept clean, it is compacted with a plate compactor. A minimum of two passes should be made with the second pass in a perpendicular direction from the first pass. The path of the plate compactor should overlap several inches (cm). For paving units 3 1/8 to 4 in. (80 to 100 mm) thick, the plate compactor should exert a minimum 5,000 lbf (22 kN) at 75 to 90 Hz. Figure 30 shows permeable pavers being compacted for a street project using a large plate compactor.

3.15 TOP UP JOINTS WITH JOINT FILLING STONE AS NEEDED AND SWEEP THE SURFACE CLEAN

Compaction can cause some settlement of the aggregates inside the joints. If the aggregates are more than 1/4 in. (6 mm) from the paver surface, they should be topped up to this level with additional aggregates. The paver surface should be swept clean prior to opening the PICP to traffic.
Aggregates in the paver joints can settle in early in the life of the pavement. Some settlement can be reduced through consistent, thorough compaction of the base, pavers and bedding layers. However, it is advisable for the contractor to return to the site after six months, inspect the joints and top them up with aggregate if they have settled to more than 1/4 in. (6 mm) below the paver surface. This service should be included in the construction specifications.

PICP = Permeable interlocking concrete pavement

SECTION 32 14 10 - UNIT PAVERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete Unit Pavers over Aggregate Sub-Base.

B. Related Sections:
1. Section 32 16, Decorative Concrete.
2. Section 05 50 00, Site Metal Fabrications.
3. Section 32 90 00; Landscape Irrigation.

1.2 REFERENCES

A. ASTM — ASTM International:
1. C 33 — Specification for Concrete Aggregates.
2. C 144 — Specification for Aggregate for Masonry Mortar.
3. C 902 — Specification for Pedestrian and Light Paving Unit.
5. D 1557 — Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.3 DEFINITIONS

A. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

B. Excessive Compaction: Planting area soil or soil mix compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

C. Landscape Architect: Landscape Architect employed by the Owner to provide professional landscape architectural services for the Project.

1.4 SUBMITTALS

A. General Requirements: Refer to Division 1.

B. Product Data:
1. Concrete Unit Pavers.
2. Joint Aggregate for Paver Joints.
3. Geotextile Fabric
4. Aggregate sub-base.
5. Aggregate bed under pavers.

C. Samples:
1. Pavers — Three full size pavers of each material and size representing size, color, and finish.
2. Joint Aggregate — 1-pound plastic bag of joint aggregate material representing size and color.
3. Geotextile — Three 6-inch squares.

D. Test Reports:
1. Aggregate sub-base with Test Date less than 4 Weeks Old.
2. Bedding Aggregate Sieve Analysis with Test Date less than 4 Weeks Old.
3. Joint Aggregate Sieve Analysis with Test Date less than 4 Weeks old.

E. Manufacturer's Instructions for Informational Purposes: Surebond Manufacturer's Current Printed Installation Instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
1. Successfully installed unit paving similar to the quality specified and in the quantity shown for a period of not less than 10 years.
2. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary
crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

B. Regulatory Requirements:
Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over such Work.

C. Unit Paving Mock-up:
1. Construct an 8-feet wide by 8-feet long area of unit paving pavers for each size of paver indicated with adjacencies and edge restraints.
2. Compact pavers on aggregate base and-setting bed, fill joints with joint aggregate, and wet.
3. Construct as many samples as necessary to achieve an accepted mock-up.
4. Mock-ups which are partially constructed or finished incorrectly will be rejected.
5. Remove rejected mock-ups immediately from the site.
6. Place accepted mock-ups in a location where samples can be referenced.
7. Mock-up panels may be installed and remain as part of the permanent installation if acceptable to the
Landscape Architect.
8. Accepted mock-up panels shall become the project standard for tolerances and appearance.

D. Pre-installation Meeting:
Prior to commencement of unit installation, schedule and conduct an on-site meeting with the Landscape Architect and the Landscape Architect's paving engineer to review the critical aspects of consolidating the aggregate-cement bedding, hydrating the aggregate-cement bedding, installing and wetting the joint aggregate, layout starting points, and other requirements of this Section.

1.6 DELIVERY, STORAGE AND HANDLING

A. Loading and Shipment:
1. Carefully pack the pavers for shipment free from stains, saw mud, and other deleterious material.
2. Exercise precautions against damage in transit.

B. Storage:

1. Store pavers on non-staining wood skids or pallets at least 4 inches above grade.
2. Place and stack skids and pavers to distribute weight evenly and to prevent breakage or cracking of pavers.
3. Store and protect pavers from weather and soiling with waterproof non-staining covers or enclosure, but
allow air to circulate around pavers.

C. Handling:

1. Handle pavers to prevent chipping, breakage, soiling or other damage.
2. Do not use pinch or wrecking bars without protecting edges of pavers with wood or other rigid materials.
3. Lift with wide-belt type slings wherever possible.
4. Do not use wire rope or ropes containing tar or other substances which might cause staining.
5. Use wood rollers and provide cushion at end of wood slides.

1.7 SITE CONDITIONS

A. Environmental Requirements: Meet requirements of joint aggregate manufacturer's current printed instructions.

1.8 WARRANTY

A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from the date of Final Completion against defects in materials and workmanship.
B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting
from defects in materials and workmanship.
C. Exceptions: Contractor shall not be held responsible for failures due to normal wear, neglect by Owner, vandalism,
and other causes outside Contractor's control.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

A. Concrete Unit Pavers: Ackerstone, Corona, CA (951) 674-0047, www.ackerstone.com.
C. Geotextile: TenCate, Pendergrass, GA (706) 693-2226.

2.2 MATERIALS

A. Unit Pavers: As indicated on the drawings.
B. Joint material: Naturally occurring, not manufactured, ASTM No. 8, stone.
C. Leveling / Bedding material: Clean, crushed or aggregate, No. 8 stone in a 1 ½" - 2" thick layer.
D. Open graded base: Clean crushed aggregate, No. 57 stone in a 4" layer.
E. Permeable subbase course materials: Clean crushed aggregate No. 2 aggregates in the bottom layer.

F. Leveling / Bedding material on structure: Clean, crushed or aggregate, No. 8 stone in a depth from bottom of paver to drainage mat.
G. Edge Restraints: GeoEdge, Permaloc Corporation (616) 399-9600.

2.3 UNIT PAVER FABRICATION TOLERANCES

A. Maximum Variation from Thickness, Face Size, and From Flat: 1/16-inch.

PART 3 EXECUTION

3.1 EXAMINATION

A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are
present which would cause defective installation of products or cause latent defects in workmanship and function.

3.2 PREPARATION

A. Protection:
1. Use every possible precaution to prevent damage to existing conditions to remain such as structures,
utilities, plant materials and walks on or adjacent to the site of the Work.
2. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from
damage during construction.

3.3 PAVER INSTALLATION

A. Spreading Aggregate Setting Bed:
1. Making allowances for compaction, screed un-compacted to a consistent thickness which will bring the finish surface of the pavers to the elevations indicated on the Drawings.
2. Check and verify effect of setting bed mix compaction in a sample panel to determine the screeded aggregatecement bed thickness.
3. Do not use setting bed mix for leveling.
4. Maintain setting bed mix in a loose condition and protected against pre-compaction both prior to and
following screeding.
5. Screed setting bed, slightly ahead of the laying the pavers.
6. Under no circumstances shall the setting bed mix be screeded in advance of the laying face to an extent to
which paving will not be completed that day.
7. Protect screeded setting bed mix fully against accidental pre-compaction including compaction by rain, dew, or other moisture.

B. Laying Pavers:
1. Place pavers on the un-compacted setting bed mix to the specified laying pattern.

2. Place pavers so that joints are aligned and installed in the pattern as shown on the Drawings.
3. Use string lines to hold pattern lines and elevations true.
4. Lay rows of full units first.
5. Cut off and fit closure units subsequently by using two combined butt jointed pavers. Do not install a paver that is less than ¼ its nominal dimensions.
6. Cut paver units with power diamond blade masonry saw where partial pavers abut straight surfaces.
7. Cut radial paver edges with a diamond-blade masonry saw by kerfing and coring or other acceptable where pavers abut round elements such as manholes, bollards and columns to achieve smoothly curved edges parallel with the abutting surfaces with butt joints or ¼" maximum width joint.
8. Do not allow other construction traffic on pavement during the paver installation until pavers have been
compacted.

C. Compaction of Pavers:
1. Achieve consolidation of the setting bed mix and bring paver surfaces to design levels by using beating block and rubber mallet.
2. Continue beating and leveling until unacceptable lippage has been eliminated and pavers are at proper
elevations.
3. Immediately remove and replace pavers which are damaged during installation.

D. Filling Upper 1/4-Inch of Joints:
1. After compaction, and prior to the termination of Work on that day and prior to the acceptance of construction traffic, cover surface of pavers with cement-free joint aggregate and sprinkle surface with water so that aggregate washes into joints and cement in bedding aggregate is activated.
2. After aggregate has dried, sweep surplus material from the surface or leave on surface during construction to insure complete filling of joints during initial use until the joint sealer is applied.

3.4 EDGING:

A. Install GeoEdge in conformance with manufactuers wrtiiten specifications. All edges to be plumb, straight and within tolerances for concrete flatwork.

3.5 TOLERANCES:

A. Paver Finished Surface: Do not permit finished paving surfaces to vary more than 1/8 inch measured with a 10-foot
long metal straightedge, except at grade changes.
B. Lippage Between Adjacent Pavers: 1/16-inch maximum.
C. Joint Widths: butt joint minimum; 1/4-inch maximum.

3.6 CLEANING

A. Pavers:
1. Prior to final inspection, clean stained or dirty pavers with clean water and stiff bristle brush.
2. Remove and replace permanently stained pavers.
3. Add additional aggregate to joints where cleaning has dislodged aggregate and re-wet joints.

3.7 PROTECTION

A. Damage and Defacement: Protect paving against damage and defacement during subsequent construction
operations until date of Final Completion by covering paving with 3/4-inch thick exterior plywood where subject to
traffic damage.

END OF SECTION

SECTION 32 1500 - AGGREGATE SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Aggregate surfacing.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 32 91 19: Finish Grading.
4. Section 32 13 13: Concrete Paving.
7. Section 32 80 00: Irrigation

1.02 REFERENCES

A. ASTM F-1632: Standard Test Method for Particle Size Analysis

B. ASTM D- 422: Standard Test Method for Fine Particle Size Analysis.

1.03 LEED REQUIREMENTS

A. Owner has established that the project will achieve LEED Certification per the requirements outlined in Section 01 35 15.

B. Following LEED requirements are mandatory for Work included in this Section in order to achieve LEED certification.

1.04 SUBMITTALS

A. See section 01 30 00 – Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

1.05 PROJECT REQUIREMENTS

A. Sub base material shall be uniformly graded and compacted, and shall mirror finish grade contours to ensure an even depth of material.

B. Survey subgrade elevations prior to placement of material.

1.06 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures.

B Submit a one pound sample and sieve analysis per ASTM C136, F-1632 for all decomposed granite aggregate surfacing.

C. Submit (3) images of available boulders with supplier and material location.

D. Submit (3) stone as representative samples with supplier and material location.

E. Manufacturer’s product data sheet and installation instructions for each product to be used.

F. MOCKUPS:

A. Prepare on-site paving and stair mock-ups as follows:

1. Prepare a minimum 4-foot square mock-up of each different decomposed granite surfacing type specified on Drawings. Label mock-ups (preferably on vertical side of mock-up) with specified paving type to facilitate mock-up review.

2. Prepare a minimum 8-foot square mock-up of aggregate mulch surfacing type specified on Drawings. Include aggregate size transition and 2-3 boulders.

3. Construct mock-ups using identical products, edging, depth and methods of overall workmanship that will be employed during production.

4. Ensure that same crew preparing mock-ups will be responsible for production work.

5. Construct mock-ups in a protected location approved by Owner. Ideally mock-ups should be located as close to production work as possible to facilitate comparison review and be located in a sunny location.

6. Approved mock-ups will be used as standard for future production work review and assessment. Owner should be prepared to physically sign mock-up using a permanent black marker to attest Owner's approval of mock-up. Rejected mock-ups can remain on-site until removal of approved mock-ups is required.

7. Owner will incur costs to redo mock-ups if Owner requires design changes during mock-up review. Contractor will incur costs to redo mock-ups if Owner rejects mock-ups due to Contractor error such as incorrect concrete mix design or unacceptable appearance.

7. Protect approved mock-ups from damage during course of Work.

8. Clean mock-ups prior to Final Walkthrough for Acceptance to facilitate unencumbered comparison review by Owner between approved mock-ups and production work.

9. Remove mock-ups from site when directed by Owner.

1.07 QUALITY ASSURANCE

A. Comply with the Standard Specifications for Public Works Construction, current edition, except as modified herein.

B. Provide evidence of successful experience by the installer in the Work of this section.

1.08 DELIVERY, STORAGE AND HANDLING

A. Do not install aggregate surfacing during rainy conditions.

PART 2 - PRODUCTS

2.01 STABILIZED DECOMPOSED GRANITE PAVING

A. Acceptable Manufacturer:

1. Specification is based on products by Gail Materials, Corona, CA; phone 951- 667-6106; fax 951-667-6102; www.gailmaterials.net.

B. Stabilized Decomposed Granite:

1. Produce from naturally friable granite. Blends of coarse sand and rock dust are not acceptable.

2. Gradation, in accordance with ASTM C136:

Sieve Size	Percent Passing
1/2”	100
3/8”	90 - 100
No. 4	50 - 100
No. 30	25 - 55
No. 100	10 - 20
No. 200	5 - 18

3. Sand Equivalent: 30 minimum in accordance with ASTM D2419.

4. Color: To be selected by Landscape Architect from manufacturer’s standard colors.

C. Binder: Provide Natracil by Gail Materials and complying with following requirements:

1. Swell Volume: 35 ml/gm minimum in accordance with USP procedures. 2. 90% minimum shall pass a No. 40 mesh screen. D. Factory Blending:

1. Mix decomposed granite and Natracil™ with a pug mill that includes a weigh-belt feeder. 2. Pedestrian Paths and Dog Park: Mix 12 lbs. of binder per 2000 lbs. of aggregate.

D. Unstabilized Decomposed Granite:

1. Produce from naturally friable granite. Blends of coarse sand and rock dust are not acceptable.

2. Gradation, in accordance with ASTM C136:

Sieve Size	Percent Passing
1/2”	100
3/8”	90 - 100
No. 4	50 - 100
No. 30	25 - 55
No. 100	10 - 20
No. 200	5 - 18

3. Sand Equivalent: 30 minimum in accordance with ASTM D2419.

4. Color: To be selected by Landscape Architect from manufacturer's standard colors.

E. Stone mulch: 2"-3" and miscellaneous sizes, see drawings.

F. Boulders: 2'-4' and miscellaneous sizes, see drawings.

G. Uncompacted decomposed granite graded at 1/8"-1/4" no fines.

H. Steel Edging:

1. Dimensions: 3/16" thick by 6-inch deep, with overlapping joints.

2. Stakes: 3/16" x 16" long x 1-3/4" wide at top tapering to point at bottom; located 36" o.c. maximum.

3. Finish: Baked-on brown paint.

PART 3 - EXECUTION

3.01 PREPARATION OF SUBGRADE

A. The sub-grade shall be graded to an elevation 3 inches lower than the finish grades indicated on the Drawings. After the areas are graded to the required elevations, they shall be compacted and/or rolled as required by Section 31 22 00 - Grading. Sub-grade shall then be dragged or floated to provide a uniform surface, free from any irregularities.

3.03 INSTALLATION OF AGGREGATE SURFACING

A. Stabilized Decomposed Granite:

1. 3 inch layer of aggregate surfacing shall then be spread evenly over the entire areas to finish grades. Grade and smooth as desired. Thoroughly water entire area so that the entire depth of the material is moist and to activate the Natracil. After a period of +/- 6 hours compact the finale lift with a 1000 – 3000 lb static drum roller. Allow for a sufficient curing period of +/- 4 days prior to use. Surface shall be filled as required and again rolled to produce a 4 inch thick uniform plane with proper drainage and slopes.

B. Unstabilized Decomposed Granite at Walking Path:

1. 3 inch layer of aggregate surfacing shall then be spread evenly over the entire areas to finish grades. Grade and smooth as desired. Thoroughly water entire area so that the entire depth of the material is moist and washed. Do not compact.

C. Stone Mulch:

1. 6"-10" inch layer of stone muclh shall then be spread evenly over the entire areas to finish grades. Grade and smooth for acceptance by the Landscape Architect. Adjust mulch until it is accepted. Thoroughly water entire area to remove fines and dust. Do not compact.

D. Boulders:

1. Excavate area to receive boulders to depths indicated on the drawings. Over excavate to allow field adjustment. Boulders are to be planted at 1/3 the dimension of the boulder and stabile. Adjust until accepted by the landscape architect.

3.04 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 32 3119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Decorative steel fences.
2. Swing gates.

B. Related Requirements:

1. Section 07 4213.13 "Formed Metal Wall Panels" for metal panels on gate.
2. Section 28 1300 "Access Control" for access control devices installed at gates and provided as part of a security system.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.

1. Include diagrams for power, signal, and control wiring.

C. Samples: For each fence material and for each color specified.

1. Provide Samples 12 inches in length for linear materials.
2. Provide Samples 12 inches square for sheet or plate materials.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For gate operators to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Accessibility: Comply with requirements of the 2010 ADA Standards and CBC 11B for gate hardware, operating force, clear floor space.

C. Provide the following upon request:

1. Field quality-control reports.

2. Product Test Reports: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard[and other specified requirements].

PART 2 - PRODUCTS

2.1 DECORATIVE STEEL FENCES

A. Decorative Steel Fences: Fences made from steel tubing bars and shapes, hot-dip galvanized.

B. Posts: Square steel tubing.

1. Horizontal-Slide Gate Post, Openings Wider Than 12 Feet: 4 by 4 inches with 3/16-inch wall thickness.

2. Guide Posts for Class 1 Horizontal-Slide Gates: 4 by 4 inches with 3/16-inch wall thickness; installed adjacent to gate post to permit gate to slide in space between.

C. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.

D. Rails:

1. Steel Tube Rails: Square steel tubing 2 by 2 inches with 1/8-inch wall thickness.

E. Infill: Custom design as indicated on Drawings.

1. Formed metal wall panels specified in Section 07 4213.13.

F. Fasteners: Stainless-steel carriage bolts and tamperproof nuts.

G. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

H. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.

1. Hot-dip galvanize custom-design rail and infill assemblies after fabrication.

I. Finish for Metallic-Coated-Steel Items[Other than Bar Grating Infill]: High-performance coating.

2.2 HORIZONTAL-SLIDE GATES

A. Gate Configuration: Double leaf.

1. Type: Cantilever slide, with external roller assemblies.

B. Gate Frame Height: As indicated.

C. Gate Opening Width: As indicated.

D. Automated vehicular gates shall comply with ASTM F 2200, Class I .

E. Galvanized-Steel Frames and Bracing: Fabricate members from square tubing.

1. Frame Members: Square tubes 2-1/2 by 2-1/2 inches formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication.

2. Bracing Members: Square tubes 2-1/2 by 2-1/2 inches formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication.

F. Frame Corner Construction:

1. Welded frame with panels assembled with bolted or riveted corner fittings and 5/16-inch-diameter, adjustable truss rods for panels 5 feet wide or wider.

G. Additional Rails: Provide as indicated, complying with requirements for fence rails.

H. Infill: Formed metal wall panels.

I. Hardware: Latches permitting operation from both sides of gate, locking devices roller assemblies and stops fabricated from galvanized steel . Comply with 2013 CBC 11B.309.4.

J. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

K. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.

L. Metallic-Coated-Steel Finish: High-performance coating.

2.3 GATE OPERATORS

A. Gate Operators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Chamberlain Group, Inc. (The).

b. Tymetal Corp.

c. USAutomatic Inc.

d. Viking Access Systems.

B. Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.

1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
2. Provide operator with UL approval.
3. Provide electronic components with built-in troubleshooting diagnostic feature.
4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.

C. Comply with NFPA 70.

D. UL Standard: Manufacturer and label gate operators to comply with UL 325.

E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.

F. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:

1. Voltage: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
2. Horsepower: Not less than 3/4.
3. Enclosure: Totally enclosed.
4. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
6. Phase: One.

G. Gate Operators: Concrete base mounted and as follows:

1. Mechanical Slide Gate Operators:
   a. Duty: Heavy duty, commercial/industrial.
   b. Gate Speed: Minimum 60 feetper minute .
   c. Maximum Gate Weight: 3000 lb.
   d. Frequency of Use: 10 cycles per hour .
   e. Operating Type: Roller chain, with manual release.
   f. Drive Type: Enclosed worm gear and chain-and-sprocket reducers, roller-chain drive.

H. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with [NEMA ICS 6, Type 1] [NEMA ICS 6, Type 4] <Insert type of enclosure> enclosure for [surface] [recessed or flush] [concrete base] [pedestal] <Insert mounting> mounting, and with space for additional optional equipment. Provide the following remote-control device(s):

1. Control Station: Keyed, [two] [three]-position switch with open[, stop,] and close function; located remotely from gate. Provide two keys per station.
2. Card Reader: Functions only when authorized card is presented. Programmable, [multiple] [single]-code system[, permitting four different access time periods] [; face-lighted unit fully visible at night].
    a. Reader Type: [Touch plate] [Swipe] [Insertion] [Proximity].
    b. Features: [Timed antipassback] [Limited-time usage] [Capable of monitoring and auditing gate activity].
3. Digital Keypad Entry Unit: [Programmable,]multiple-code capability of not less than [five] [500] [2500] <Insert number> possible individual codes, consisting of [1- to 7] [4] [5]-digit codes[, and permitting four different access time periods].
    a. Features: [Timed antipassback] [Limited-time usage] [Capable of monitoring and auditing gate activity].
    b. Face-lighted unit with [metal-keyed] [keyless-membrane] keypad fully visible at night.
4. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located where indicated, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide [one] [two] <Insert number> programmable transmitter(s) with multiple-code capability permitting validating or voiding of not less than [1000] [10,000] <Insert number> codes per channel configured for the following functions:
    a. Transmitters: [Single] [Three] button operated, with open [and close]function.
    b. Channel Settings: [Two] [Three] [Four] <Insert number> independent channel settings controlling separate receivers for operating more than one gate from each transmitter.

I. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:

1. Action: Reverse gate in both opening and closing cycles, and hold until clear of obstruction.
2. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.

J. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.

K. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type, permitting manual operation if operator fails. Design system so control-circuit power is disconnected during manual operation.

1. Type: Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge.

L. Operating Features:

1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features[with capability for monitoring and auditing gate activity]. Provide unit that is isolated from voltage spikes and surges.
2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
4. Automatic Closing Timer: With adjustable time delay before closing[and timer cutoff switch].
5. Open Override Circuit: Designed to override closing commands.
6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
8. Clock Timer: [24-hour] [Seven-day] <Insert time period> programmable for regular events.

M. Accessories:

1. Warning Module: [Audio] [Visual], [constant] [strobe]-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving; compliant with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system:
   a. Fail-Safe: Gate opens and remains open until power is restored.
   b. Fail-Secure: Gate cycles on battery power, then fail-safe when battery is discharged.
3. External electric-powered [solenoid] [magnetic] lock with delay timer allowing time for lock to release before gate operates.
4. [Fire] [Postal] box.
5. Fire [strobe] [siren] sensor.
6. Intercom System: <Insert requirements>.
7. Instructional, Safety, and Warning Labels and Signs: [According to UL 325] [Manufacturer's standard for components and features specified] [As indicated on Drawings] <Insert requirements>.
8. Equipment Bases/Pads: Precast concrete, [depth not less than 12 inches] <Insert depth>, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

2.4 STEEL AND IRON

A. Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

C. Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 50, with [G90] [G60] coating.

2.5 COATING MATERIALS

A. Shop Primer for Steel: Manufacturer's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 03 3000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C 387/C 387M mixed with potable water according to manufacturer's written instructions.

2.7 METALLIC-COATED-STEEL FINISHES

A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

B. Powder Coating: Immediately after cleaning and pretreating, apply two-coat finish consisting of zinc-rich epoxy prime coat and TGIC polyester topcoat, with a minimum dry film thickness of 2 mils for topcoat. Comply with coating manufacturer's written instructions to achieve a minimum total dry film thickness of 4 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.
2. Comply with surface finish testing requirements in ASTM F 2408 except change corrosion-resistance requirement to 3000 hours without failure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Section 01 7300 "Execution."

3.3 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.4 GATE OPERATOR INSTALLATION

A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation for Support Posts Concrete Bases: Hand-excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.

C. Concrete Bases: Cast-in-place or precast concrete, depth not less than 12 inches, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

D. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.5 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices,[alarms,] and limit switches.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lubricate hardware, gate operators, and other moving parts.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION

SECTION 02810 - LANDSCAPE IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. It is the intent of the specifications and drawings that the finished system is complete in every respect and shall be ready for operation satisfactory to the University.

B. The work shall include all materials, labor, services, transportation, and equipment necessary to perform the work as indicated on the drawings, in these specifications, and as necessary to complete the contract.

1.2 CONSTRUCTION DRAWINGS

A. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, sleeves, etc. which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.

B. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it shall be deemed to be as shown on both. The Landscape Architect shall have final authority for clarification.

C. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Landscape Architect as soon as detected. In the event this notification is not performed, the Irrigation Contractor shall assume full responsibility for any revision necessary.

1.3 QUALITY ASSURANCE

A. Provide at least one English speaking person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation and who shall direct all work performed under this section.

B. Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturer of articles used in this contract furnish directions covering points not shown in the drawings and specifications.

C. All local, municipal, and state laws, rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with any of the above rules and regulations of the same. However, when these specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these specifications and drawings shall take precedence.

D. All materials supplied for this project shall be new and free from any defects. All defective materials shall be replaced immediately at no additional cost to University.

E. The Contractor shall secure the required licenses and permits including payments of charges and fees, give required notices to public authorities, verify permits secured or arrangements made by others affecting the work of this section.

1.4 SUBMITTALS

A. Water Pressure Test
1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the University a written verification of the existing water pressure on the project at each of the points of connection shown.
2. The water pressure test shall be performed to measure the dynamic water pressure at the point of connection at the maximum flow rate of the proposed irrigation system as shown on the point of connection note. Dynamic water pressure is when water is flowing through the point of connection. Static water pressure readings, water is not flowing, are not acceptable.
3. Written dynamic water pressure test confirmation shall be made on the contractor's letterhead and include the flow rate during the test, the recorded water pressure, the date of the test and the time of the test.

B. Material List:
1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the University a complete list of all irrigation system materials, or processes proposed to be furnished and installed as part of this contract.
2. The submittals materials list shall include the following information:
   a. A title sheet with the job name, the contractor's name, contractor's address and telephone number, submittal date and submittal number.
   b. An index sheet showing the item number (i.e. 1,2,3, etc.); an item description (i.e. sprinkler head); the manufacturer's name (i.e. Hunter Industries); the item model number (i.e. I-40-ADV/36V); and the page(s) in the submittal set that contain the catalog cuts.
   c. The catalog cuts shall be one or two pages copied from the most recent manufacturer's catalog that indicate the product submitted. Do not submit parts lists, exploded diagrams, price lists or other extra information.

d. The catalog cuts shall clearly indicate the manufacturer's name and the item model number. The item model number, all specified options and specified sizes shall be circled on the catalog cuts.
e. Submittals for equipment indicated on the legend without manufacturer names, or "as approved", shall contain the manufacturer, Class or Schedule, ASTM numbers and/or other certifications as indicated in these specifications.

3. Submittal materials list format requirements:
   a. Submittals shall be provided as one complete package for the project. Multiple partial submittals will not be reviewed.
   b. Submittal package shall be stapled or bound in such a way as to allow for disassembly for review processing. Submittals shall not have tabs, tab sheets, spiral binding, or any other type of binding that will interfere with automated copying of submittals.
   c. Submittal package shall have all pages numbered in the lower right hand corner. Page numbers shall correspond with submittal index.
   d. Re-submitted packages must be revised to include only the equipment being re-submitted. Equipment previously reviewed and accepted shall not be re-submitted in the materials list/index sheet or in the catalog cut sheet package.

C. Substitutions: If the Irrigation Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the irrigation drawings and specifications, he may do so by providing the following information to the Landscape Architect or University's authorized representative for approval.
   1. Provide a written statement indicating the reason for making the substitution.
   2. Provide catalog cut sheets, technical data, and performance information for each substitute item.
   3. Provide in writing the difference in installed price if the item is accepted.

D. The Landscape Architect or University's authorized representative will allow no substitutions without prior written acceptance

E. No substitutions of pump manufacturers, distributors or assemblies will be accepted.

F. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.

G. The Landscape Architect or University's authorized representative will not review the submittal package unless provided in the format described above.

1.5 EXISTING CONDITIONS

A. The Contractor shall verify and be familiar with the locations, size and detail of points of connection provided as the source of water, and electrical supply connection to the irrigation system.

B. Irrigation design is based on the available static water pressure shown on the drawings. Contractor shall verify static water on the project prior to the start of construction. Should a

discrepancy exist, notify the Landscape Architect and University's authorized representative prior to beginning construction.

C. Prior to cutting into the soil, the Contractor shall locate all cables, conduits, sewer septic tanks, and other utilities as are commonly encountered underground and he shall take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, the Contractor shall promptly notify the Landscape Architect and University who will arrange for relocations. The Contractor will proceed in the same manner if a rock layer or any other such conditions are encountered.

D. The Contractor shall protect all existing utilities and features to remain on and adjacent to the project site during construction. Contractor shall repair, at his own cost; all damage resulting from his operations or negligence.

E. The Irrigation Contractor shall coordinate with the General Contractor for installation of required sleeving as shown on the plans prior to paving operations.

F. The Contractor shall verify and be familiar with the existing irrigation systems in areas adjacent to and within the Project area of work.

G. The Contractor shall protect all existing irrigation systems, in areas adjacent to and within the project area of work, from damage due to his operations.

H. Contractor shall notify University’s Representative if any existing system is temporarily shut off, capped or modified. Provide 48-hour notice, prior to turning off or modifying any existing irrigation system.

I. The Contractor shall repair or replace all existing irrigation systems, in areas adjacent to and within the project area of work, damaged by the construction of this project. Adjacent irrigation systems shall be made completely operational and provide complete coverage of the existing landscaped areas. All repairs shall be complete to the satisfaction of the University’s Representative.

J. The contractor shall provide bore holes under any existing pavement or paving encountered for the required lateral, mainline and low voltage control wire sleeving. Bore holes under 2 inches in diameter and smaller shall be made with a BulletMole® underground boring tool as manufactured by Dimension Tools, LLC (Contact telephone number (888)-650-5554 or at www.bulletmole.com). Bore holes larger than 2 inches in diameter shall be made with an approved mechanical boring tool. No air jacking or hydraulic boring of any kind shall be allowed.

1.6 INSPECTIONS

A. The Contractor shall permit the Landscape Architect and University's authorized representative to visit and inspect at all times any part of the work and shall provide safe access for such visits.

B. Where the specifications require work to be tested by the Contractor, it shall not be covered over until accepted by the Landscape Architect, University's authorized representative, and/or governing agencies. The Contractor shall be solely responsible for notifying the Landscape Architect, University, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing. Should any work be covered without testing or acceptance, it shall be, if so ordered, uncovered at the Contractor's expense.

C. Inspections will be required for the following at a minimum:
   1. Pre-construction meeting.
   2. System layout.
   3. Pressure test of irrigation mainline (Four hours at 125 PSI or 120% of static water pressure, whichever is greater.) Mainline pressure loss during test shall not exceed 2 PSI.
   4. Coverage test of irrigation system. Test shall be performed prior to any planting.
   5. Final inspection prior to start of maintenance period.
   6. Final acceptance prior to turnover.

D. Site observations and testing will not commence without the field record drawings as prepared by the Irrigation Contractor. Record drawings must be complete and up to date for each site visit.

E. Work that fails testing and is not accepted will be retested. Hourly rates and expenses of the Landscape Architect, University's authorized representative, and governing agencies for re-inspection or retesting will be paid by the Irrigation Contractor at no additional expense to University.

1.7 STORAGE AND HANDLING

A. Use all means necessary to protect irrigation system materials before, during, and after installation and to protect the installation work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Landscape Architect and University and at no additional cost to the University.

B. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install. Transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

1.8 CLEANUP AND DISPOSAL

A. Dispose of waste, trash, and debris in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no such waste material and debris on the site. Burning of trash and debris will not be permitted. The Contractor shall remove and dispose of rubbish and debris generated by his work and workmen at frequent intervals or when ordered to do so by the University's authorized representative.

B. At the time of completion the entire site will be cleared of tools, equipment, rubbish and debris which shall be disposed of off-site in a legal disposal area.

1.9 TURNOVER ITEMS

A. Record Drawings:
1. Record accurately on one set of drawings all changes in the work constituting departures from the original contract drawings and the actual final installed locations of all required components as shown below.
2. The record drawings shall be prepared to the satisfaction of the University. Prior to final inspection of work, submit record drawings to the Landscape Architect or University's authorized representative.
3. All record drawings shall be prepared using AutoCAD 2016 drafting software and the original irrigation drawings as a base. No manual drafted record drawings shall be acceptable. The Contractor may obtain digital base files from the Landscape Architect or University's authorized representative.
4. If the Contractor is unable to provide the AutoCAD drafting necessary for the record drawings the irrigation designer does provide record drawing drafting as a separate service.
5. Prior to final inspection of work, submit record drawings plotted onto vellum sheets for review by the Landscape Architect or University's authorized representative. After acceptance by the Landscape Architect, City Inspector or University's authorized representative re-plot the record drawings onto reproducible Mylar sheets. The Contractor shall also provide record drawing information on a digital AutoCAD Release 2016 drawing file. All digital files shall be provided on a compact disc (CD) clearly marked with the project name, file descriptions and date.
    a. Record drawing information and dimensions shall be collected on a day-to-day basis during the installation of the pressure mainline to fully indicate all routing locations and pipe depths. Locations for all other irrigation equipment shall be collected prior to the final inspection of the work.
    b. Two dimensions from two permanent points of reference such as buildings, sidewalks, curbs, streetlights, hydrants, etc. shall be shown for each piece of irrigation equipment shown below. Where multiple components are installed with no reasonable reference point between the components, dimensioning may be made to the irrigation equipment. All irrigation symbols shall be clearly shown matching the irrigation legend for the drawings. All lettering on the record drawings shall be minimum 1/8 inch in size.
6. Show locations and depths of the following items:
    a. Point of connection (including water POC, backflow devices, master control valves, flow sensors, etc.)
    b. Routing of sprinkler pressure main lines (dimensions shown at a maximum of 100 feet along routing)
    c. Isolation valves
    d. Automatic remote control valves (indicate station number and size)
    e. Quick coupling valves
    f. Drip air relief and flush valves
    g. Routing of control wires where separate from irrigation mainline
    h. Irrigation controllers (indicate controller number and station count)
    i. Related equipment (as may be directed)

B. Controller Charts:

1. Provide one controller chart for each automatic controller. Chart shall show the area covered by the particular controller. The areas covered by the individual control valves shall be indicated using colored highlighter pens. A minimum of six individual colors shall be used for the controller chart unless less than six control valves are indicated.
2. Landscape Architect or University's authorized representative must approve record drawings before controller charts are prepared.
3. The chart is to be a reduced copy of the actual "record" drawing. In the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a readable size.
4. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils in thickness.

C. Operation and Maintenance Manuals:
1. Two individually bound copies of operation and maintenance manuals shall be delivered to the Landscape Architect or University's authorized representative at least 10 calendar days prior to final inspection. The manuals shall describe the material installed and the proper operation of the system.
2. Each complete, bound manual shall include the following information:
3. Index sheet stating Contractor's address and telephone number, duration of guarantee period, list of equipment including names and addresses of local manufacturer representatives.
   a. Operating and maintenance instructions for all equipment.
   b. Spare parts lists and related manufacturer information for all equipment.

D. Equipment:
1. Supply as a part of this contract the following items:
   a. Two (2) wrenches for disassembly and adjustment of each type of sprinkler head used in the irrigation system.
   b. Three 30-inch sprinkler keys for manual operation of control valves.
   c. Two keys for each automatic controller.
   d. Two quick coupler keys with a 1" bronze hose bib, bent nose type with hand wheel and two coupler lid keys.
   e. One valve box cover key or wrench.
   f. Six extra sprinkler heads of each size and type.
   g. For specified ball valves if required: One (1) 5-foot long valve handle, to fit the specified ball valves.
2. The above equipment shall be turned over to University's authorized representative at the final inspection.

1.10 COMPLETION

A. At the time of the pre-maintenance period inspection, the Landscape Architect, University's authorized representative, and governing agencies will inspect the work, and if not accepted, will prepare a list of items to be completed by the Contractor. Punch list to be checked off by contractor and submitted to Landscape Architect or University’s authorized representative prior to any follow-up meeting. This checked off list to indicate that all punch list items have been completed. At the time of the post-maintenance period or final inspection the work will

be re-inspected and final acceptance will be in writing by the Landscape Architect, University's authorized representative, and governing agencies.

B. The University's authorized representative shall have final authority on all portions of the work.

C. After the system has been completed, the Contractor shall instruct University's authorized representative in the operation and maintenance of the irrigation system and shall furnish a complete set of operating and maintenance instructions.

D. Any settling of trenches which may occur during the one-year period following acceptance shall be repaired to the University's satisfaction by the Contractor without any additional expense to the University. Repairs shall include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

1.11 GUARANTEE

A. The entire sprinkler system, including all work done under this contract, shall be unconditionally guaranteed against all defects and fault of material and workmanship, including settling of backfilled areas below grade, for a period of one (1) year following the filing of the Notice of Completion.

B. Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to University within ten (10) calendar days of receipt of written notice from University. When the nature of the repairs as determined by the University constitute an emergency (i.e. broken pressure line) the University may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the University by the Contractor, all at no additional cost to the University.

C. Guarantee shall be submitted on Contractors own letterhead as follows:

GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defective material during the period of one year from date of filing of the Notice of Completion and also to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the University. We shall make such repairs or replacements within 10 calendar days following written notification by the University. In the event of our failure to make such repairs or replacements within the time specified after receipt of written notice from University, we authorize the University to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT NAME:
PROJECT LOCATION:

CONTRACTOR NAME:
ADDRESS:

TELEPHONE:

SIGNED:

DATE:

PART 2 - MATERIALS

2.1 SUMMARY

Use only new materials of the manufacturer, size and type shown on the drawings and specifications. Materials or equipment installed or furnished that do not meet Landscape Architect's, University's, or governing agencies standards will be rejected and shall be removed from the site at no expense to the University.

2.2 PIPE

A. Pressure supply line between the water meter and the backflow prevention device shall be type K copper, one size larger than backflow device.

B. Backflow prevention assemblies, and all other above grade assemblies, shall be constructed of threaded brass pipe and threaded brass fittings the same size as the backflow device, unless otherwise directed.

C. Pressure supply lines 2 inches in diameter and up to 3 inches in diameter downstream of backflow prevention unit shall be Class 315 solvent weld PVC. Piping shall conform to ASTM D2241.

D. Non-pressure lines 3/4 inch in diameter and larger downstream of the remote control valve shall be SCH 40 solvent weld PVC conforming to ASTM D1785.

E. Recycled water PVC pipe to be color-coded purple in color marked on two sides with recycled water warning statements “Caution-Recycled Water”. Recycled water piping must be accepted by the local recycled water governing agencies.

2.3 METAL PIPE AND FITTINGS

A. Brass pipe shall be 85 percent red brass, ANSI, IPS Standard 125 pounds, Schedule 40 screwed pipe.

B. Fittings shall be medium brass, screwed 125-pound class.

C. Copper pipe and fittings shall be Type "K" sweat soldered, or brazed as indicated on the drawings.

2.4 PLASTIC PIPE AND FITTINGS

A. Pipe shall be marked continuously with manufacturer's name, nominal pipe size, schedule or class, PVC type and grade, National Sanitation Foundation approval, Commercial Standards designation, and date of extrusion.

B. All plastic pipe shall be extruded of an improved PVC virgin pipe compound in accordance with ASTM D2672, ASTM D2241 or ASTM D1785.

C. All solvent weld PVC fittings shall be standard weight Schedule 40 (and Schedule 80 where specified on the irrigation detail sheet, all mainline fittings shall be Schedule 80 PVC) and shall be injection molded of an improved virgin PVC fitting compound. Slip PVC fittings shall be the "deep socket" bracketed type. Threaded plastic fittings shall be injection molded. All tees and ells shall be side gated. All fittings shall conform to ASTM D2464 and ASTM D2466.

D. All threaded nipples shall be standard weight Schedule 80 with molded threads and shall conform to ASTM D1785.

E. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy. Solvent cementing shall be in conformance with ASTM D2564 and ASTM D2855.

F. When connection is plastic to metal, female adapters shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be non-lead base Teflon paste, tape, or equal.

G. All pressure mainlines installed with solvent weld PVC fittings shall be installed with concrete thrust blocking at all directional changes in the mainline routing. Concrete thrust blocking shall not be required when ductile iron fittings and mechanical restraints are specified.

2.5 VALVES

A. Gate Valves:
   1. Gate valves shall be of the manufacturer, size, and type indicated on the drawings.
   2. All gate valves shall have a minimum working pressure of not less than 150 PSI and shall conform to AWWA standards.

B. Quick Coupler Valves:
   1. Quick coupler valves shall be of the manufacturer, size, and type indicated on the drawings.
   2. Quick coupler valves shall be brass with a wall thickness guaranteed to withstand normal working pressure of 150 psi without leakage. Valves shall have 1" female threads opening at base, with two-piece body. Valves to be operated only with a coupler key, designed for that purpose. Coupler key is inserted into valve and a positive, watertight connection shall be made between the coupler key and valve.
   3. Vinyl quick coupler cover for recycled water systems to be purple in color with the words "Warning-Recycled Water-Do Not Drink" permanently marked on lid.

C. Automatic Control Valves:
   1. Automatic control valves shall be of the manufacturer, size, and type indicated on the drawings.
   2. Automatic control valves shall be electrically operated.
   3. Provide Christy's valve ID tags for each remote control valve with valve number.

2.6 VALVE BOXES

A. Valve boxes shall be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils.

B. The valve box cover for potable water irrigation systems shall be green in color, for recycled water systems shall be purple in color and secured with a hidden latch mechanism or bolts.

C. The cover and box shall be capable of sustaining a load of 1,500 pounds.

D. Valve box extensions shall be by the same manufacturer as the valve box.

E. The plastic irrigation valve box cover shall be an overlapping type.

F. Automatic control valve, master valve, and flow sensor boxes shall be 17"x11"x12" 'nominal' rectangular size. Valve box covers shall be marked "RCV" with the valve identification number, or "MV", "FS" "heat branded" onto the cover in 1-1/4 inch high letters / numbers.

G. Drip air relief valve boxes shall be 6" circular size. Valve box covers shall be marked with "ARV" "heat branded" onto the cover in 1-1/4 inch high letters.

H. Quick coupler and gate valve boxes shall be 10" circular size. Valve box covers shall be marked with "QCV" or "Gate" "heat branded" onto the cover in 1-1/4 inch high letters.

2.7 AUTOMATIC CONTROLLER

A. Automatic controller shall be of the manufacturer, size, and type indicated on the drawings.

B. Controller enclosure shall be of the manufacturer, size, and type indicated on the drawings.

C. Controller shall be grounded according to local codes using equipment of the manufacturer, size, and type indicated on the drawings; or as required by local codes and ordinances.

2.8 ELECTRICAL

A. All electrical equipment shall be NEMA Type 3, waterproofed for exterior installations.

B. All electrical work shall conform to local codes and ordinances.

2.9 LOW VOLTAGE CONTROL WIRING

A. Remote control wire shall be direct-burial AWG-UF type, size as indicated on the drawings, and in no case smaller than 14 gauge.

B. Remote control wire shall be 14 AWG solid core twisted pair, type as indicated on the irrigation drawings.

C. Connections shall of the manufacturer, size, and type indicated on the drawings.

D. Ground wires shall be green in color or bare copper and in no case smaller than 6 gauge.

2.10 IRRIGATION HEADS AND DRIP EMITTERS AND INLINE DRIP TUBING

A. Irrigation heads, drip emitters and inline drip tubing shall be of the manufacturer, size, type, with radius of throw, operating pressure, and discharge rate indicated on the drawings.

B. Irrigation heads, drip emitters and inline drip tubing shall be used as indicated on the drawings.

2.11 DRIP IRRIGATION EQUIPMENT

Drip tubing equipment such as flush valves, air relief valves, wye strainers and pressure regulators shall be of the manufacturer, size, and type indicated on the drawings.

2.12 MISCELLANEOUS EQUIPMENT

A. Landscape Fabric:
   1. Landscape fabric for valve box assemblies shall be 5.0- oz. weight woven polypropylene weed barrier. Landscape fabric shall have a burst strength of 225 PSI, a puncture strength of 60 lbs. and capable of water flow of 12 gallons per minute per square foot.
   2. Type: DeWitt Pro 5 Weed Barrier or approved equal.

B. Equipment such as flow sensors, rain sensors, flush valves, air relief valves, wye strainers, and master valves shall be of the manufacturer, size and type indicated on the drawings.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Inspections:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.

B. Discrepancies:
1. In the event of discrepancy, immediately notify the Landscape Architect or University's authorized representative.
2. Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved.

C. Grades:
1. Before starting work, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths with respect to finish grade.
2. Final grades shall be accepted by the Engineer before work on this section will be allowed to begin.

D. Field Measurements:
1. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design. Contractor shall coordinate the installation of all irrigation materials with all other work.
2. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions prior to proceeding with work under this section.
3. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities, which are caused by his operations or neglect.

E. Diagrammatic Intent:
The drawings are essentially diagrammatic. The size and location of equipment and fixtures are drawn to scale where possible. Provide offsets in piping and changes in equipment locations as necessary to conform with structures and to avoid obstructions or conflicts with other work at no additional expense to University.

F. Layout:
1. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads, valves, backflow preventer, and automatic controller.
2. Layout irrigation system and make minor adjustments required due to differences between site and drawings. Where piping is shown on drawings under paved areas, but running parallel and adjacent to planted areas, install the piping in the planted areas.

G. Water Supply:
Connections to, or the installation of, the water supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to University.

H. Electrical Service:

1. Connections to the electrical supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to University.
2. Contractor shall make electrical connections to the irrigation controller. Electrical power source to controller locations shall be provided by others.
3. Contractor shall make electrical connections to the irrigation controller. 230-volt single-phase electrical power source to pump assembly location shall be provided by others per NEC codes.

3.2 TRENCHING

A. Excavations shall be straight with vertical sides, even grade, and support pipe continuously on bottom of trench. Trenching excavation shall follow layout indicated on drawings to the depths below finished grade and as noted. Where lines occur under paved area, these dimensions shall be considered below subgrade.

B. Provide minimum cover of 24 inches on pressure supply lines 2 ½ inches and smaller.

C. Provide minimum cover of 24 inches for control wires within planters.

D. Provide minimum cover of 24 inches for control wires within sleeves below paving.

E. Provide minimum cover of 36 inches on pressure supply lines under vehicular travel ways.

F. Provide minimum cover of 12 inches for non-pressure lines.

G. Pipes installed in a common trench shall have a 6-inch minimum space between pipes.

3.3 THRUST BLOCKS

A. Thrust blocks must be constructed of Class “B” concrete.

B. Thrust blocks shall be poured against undisturbed site soil.

C. PVC fitting joints shall be kept free of concrete. Do not encase fitting in concrete.

D. Thrust blocking shall be sized to provide the minimum bearing areas as shown below. Bearing areas indicated have been calculated for Class 200 PVC pipe at a test pressure of 150 PSI in soil with 2,000 PSI bearing capacity. Increase thrust block sizing as necessary for varying soil conditions.
   1. Provide a minimum thrust block bearing area of 2.0 square feet on all bends (all degrees) and tees installed on pressure supply lines 4 inches and smaller.

3.4 BACKFILLING

A. Backfill material on all lines shall be the same as adjacent soil free of debris, litter, and rocks over 1/2 inches in diameter.

B. Backfill shall be tamped in 4-inch layers under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Backfill materials shall be sufficiently damp to permit thorough compaction, free of voids. Backfill shall be compacted to dry density equal to adjacent undisturbed soil and shall conform to adjacent grades.

C. Flooding in lieu of tamping is not allowed.

D. Under no circumstances shall truck wheels be used to compact backfill.

E. Provide sand backfill a minimum of 4 inches over and under all piping under paved areas.

3.5 PIPING

A. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. No hydraulic driving is permitted under asphalt pavement.

B. Cutting or breaking of existing pavement is not permitted.

C. Carefully inspect all pipe and fittings before installation, removing dirt, scale, burrs, and reaming. Install pipe with all markings up for visual inspection and verification.

D. Remove all dented and damaged pipe sections.

E. All lines shall have a minimum clearance of 4 inches from each other and 12 inches from lines of other trades.

F. Parallel lines shall not be installed directly over each other.

G. In solvent welding, use only the specified primer and solvent cement and make all joints in strict accordance with the manufacturer's recommended methods including wiping all excess solvent from each weld. Allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.

H. PVC pipe shall be installed in a manner, which will provide for expansion and contraction as recommended by the pipe manufacturer.

I. Center load all plastic pipe prior to pressure testing.

J. All threaded plastic-to-plastic connections shall be assembled using Teflon tape or Teflon paste.

K. For plastic-to-metal connections, work the metal connections first. Use a non-hardening pipe dope an all threaded plastic-to-metal connections, except where noted otherwise. All plastic-to-metal connections shall be made with plastic male adapters.

3.6 CONTROLLER

A. The exact location of the controller shall be approved by the Landscape Architect or University's authorized representative before installation. The electrical service shall be coordinated with this location.

B. The Irrigation Contractor shall be responsible for the final electrical hook up to the irrigation controller.

C. The irrigation system shall be programmed to operate during the periods of minimal use of the design area.

3.7 CONTROL WIRING

A. Low voltage control wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines whenever possible.

B. Where more than one wire is placed in a trench, the wiring shall be taped together in a bundle at intervals of 10 feet. Bundle shall be secured to the mainline with tape at intervals of 20 feet.

C. All connections shall be of an approved type and shall occur in a valve box. Provide an 18-inch service loop at each connection.

D. An expansion loop of 12 inches shall be provided at each wire connection and/or directional change, and one of 24 inches shall be provided at each remote control valve.

E. A continuous run of wire shall be used between a controller and each remote control valve. Under no circumstances shall splices be used without prior approval.

3.8 VALVES

A. Automatic control valves, quick coupler, and ball valves are to be installed in the approximate locations indicated on the drawings.

B. Valve shall be installed in shrub areas whenever possible.

C. Install all valves as indicated in the detail drawings.

D. Valves to be installed in valve boxes shall be installed one valve per box.

E. Provide valve ID tags for each remote control valve with valve number.

3.9 VALVE BOXES

A. Valve boxes shall be installed in shrub areas whenever possible.

B. Each valve box shall be installed on a foundation of 3/4 inch gravel backfill, 3 cubic feet minimum. Valve boxes shall be installed with their tops 1/2 inch above the surface of surrounding finish grade in lawn areas and 2 inches above finish grade in ground cover areas.

3.10 IRRIGATION HEADS DRIP EMITTERS AND INLINE DRIP TUBING

A. Irrigation heads, drip emitters and inline drip tubing shall be installed as indicated on the drawings.

B. Spacing of heads and inline drip tubing shall not exceed maximum indicated on the drawings.

C. Riser nipples shall be of the same size as the riser opening in the sprinkler body.

3.11 MISCELLANEOUS EQUIPMENT

A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practices.

B. Quick coupler valves shall be set approximately 18 inches from walks, curbs, header boards, or paved areas where applicable.

C. Install devices such as rain sensors, flush valves, and air relief valves, master valves and flow sensors as indicated on the drawings and as recommended by the manufacturer.

3.12 FLUSHING THE SYSTEM

A. Prior to installation of irrigation heads, the valves shall be opened and a full head of water used to flush out the lines and risers.

B. Irrigation heads shall be installed after flushing the system has been completed.

3.13 ADJUSTING THE SYSTEM

A. Contractor shall adjust valves, align heads, and check the coverage of each system prior to coverage test.

B. If it is determined by the Landscape Architect or University's authorized representative that additional adjustments or nozzle changes will be required to provide proper coverage, all necessary changes or adjustments shall be made prior to any planting.

C. The entire system shall be operating properly before any planting operations commence.

D. Automatic control valves are to be adjusted so that the irrigation heads, drip emitters and inline drip tubing operate at the pressure recommended by the manufacturer.

3.14 TESTING AND OBSERVATION

A. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been observed, tested and accepted by the Landscape Architect, University, and governing agencies.

B. The Contractor shall be solely responsible for notifying the Landscape Architect, University, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing.

C. When the sprinkler system is completed, the Contractor shall perform a coverage test of each system in its entirety to determine if the water coverage for the planted areas is complete and adequate in the presence of the Landscape Architect.

D. The Contractor shall furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from the plans, or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate, without bringing this to the attention of the Landscape Architect. This test shall be accepted by the Landscape Architect and accomplished before starting any planting.

E. Areas to be maintained for the formal maintenance period shall start maintenance at the same time, as directed by the Landscape Architect, University, and governing agencies. Partial areas will not be released into maintenance prior to completion of items listed in the pre-maintenance review. The maintenance period may not be phased.

F. If, after the maintenance review, the irrigation systems are not accepted by the Landscape Architect, the contractor shall reimburse the Architect for additional site visits, or additional time required to review work. All additional time will be billed at the Architect's hourly rate and will be paid for by the contractor at no additional cost to the University.

G. Final inspection will not commence without record drawings as prepared by the Irrigation Contractor.

3.15 MAINTENANCE

During the maintenance period the Contractor shall adjust and maintain the irrigation system in a fully operational condition providing complete irrigation coverage to all intended plantings.

3.16 COMPLETION CLEANING

Clean up shall be made as each portion of the work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be swept, and any damage sustained on the work of others shall be repaired to original conditions.

END OF SECTION

SECTION 32 8410 - UV DISINFECTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, equipment, and appurtenances for a closed pressure vessel, medium pressure, high-intensity UV disinfection system with control equipment and accessories.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Motor Control : 262419

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the General Provisions

B. Submit electrical and controls shop drawings for approval

C. Submit dimensional drawings. Show materials of construction by ASTM reference and grade. Show coatings. Show design of pressure vessel and accessories.

D. Submit installation requirements including support requirements.

E. Submit hydraulic calculations demonstrating compliance with the specified hydraulic characteristics.

F. Submit head loss calculations.

G. Submit documentation that equipment provided has CSA or UL rating.

H. Submit a bioassay calculation as well as an independently produced bioassay report on the proposed UV equipment. The bioassay calculations shall demonstrate that the proposed UV system design will deliver the intended dose.

I. Submit documentation of previous performance by submitting the following information and samples:

1. At least three installations in California that have been in operation for at least two years with the same lamp and ballast configuration proposed for this project. The installation must be similar disinfecting at least 50 gpm flow. Submit the following information for each installation:

    a. Name of facility.

b. Owner.

c. Contact name and title.

d. Telephone number.

e. Average flow capacity of facility.

f. Peak design flow capacity of facility.

g. Design criteria.

h. System start-up date.

J. Submit a letter from the California Department of Public Health certifying the proposed system meets the Title 22 requirements for RW irrigation applications along with conditions and supporting documentation.

K. Submit a statement by the equipment manufacturer listing any deviations or exceptions taken to these specifications. Include specification reference and proposed alternative with reason stated for exception.

L. UV unit shall operation shall be controlled by the irrigation pump operation. UV unit will work only when the irrigation pump is working.

M. Submit operation and maintenance manuals

N. Submit required certification.

1.04 MANUFACTURER'S EXPERIENCE CRITERIA

A. If the UV disinfection system manufacturer's standard equipment does not meet these specifications, the manufacturer shall modify their standard design to meet the minimum values specified for dimensions, design, and intent.

B. Manufacturers shall show evidence of quality assurance in manufacturing and supplying equipment essential in details to the equipment herein specified. This assurance shall be demonstrated by certification to the quality system requirements of ISO 9001.

1.05 PERFORMANCE REQUIREMENTS

A. At the time of bid, the UV manufacturer shall provide a validation certificate, to demonstrate that it has obtained third-party validation that covers the full range of the specified design and operating conditions (flow rate and UVT). The selected UV manufacturer shall provide the validation report as part of the submittal package to substantiate the dose delivery (RED).

B. The system shall be able to continue providing disinfection while the automatic cleaning system is in operation.

C. The system shall be able to continue providing disinfection while the UV intensity sensor calibration is being checked.

1.06 MANUFACTURER'S SERVICES

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

A. One labor days to check the installation and advise during start-up, testing, and adjustment of the equipment and instruct the Owner's personnel in the operation and maintenance of the equipment.

B. PART 2 - MATERIALS

2.01 MANUFACTURER

The UV disinfection system shall be a UVSwift® system as manufactured by Trojan Technologies, Inc., or equal.

2.02 UV REACTOR

A. The UV reactor shall be of welded Type 316L stainless steel construction. The UV reactor shall be pickled, passivated, and bead blasted for uniform external finish.

B. Prior to shipment from the factory, the UV reactor shall be fully assembled and hydrostatically tested to 1.5 times the design pressure for at least 10 minutes without leakage.

C. Provide each UV reactor with ASME B16.5, Class 150 flanged inlet/outlet connections.

D. Each UV reactor shall consist of high-intensity medium pressure UV lamps arranged horizontally and perpendicular to the direction of flow. Each lamp shall be enclosed in an individual quartz sleeve, one end of which shall be closed and the other sealed with compressed O-rings. Each quartz sleeve shall be independently sealed within the reactor.

E. Design the UV reactor such that operating personnel can change the lamps without draining the reactor. Provide the UV reactor with access ports for easy access to the quartz sleeves and cleaning system.

F. Design piping so that the reactor will be full of water at all times. Air trapped in the reactor shall result in reactor shut down to avoid overheating.

G. Install the UV reactor either vertically or horizontally; however, lamps must be installed horizontally.

H. The UV lamps shall reach maximum UV output within three minutes (defined as the warm-up period). Cooling water shall not be required for reactor start-up as long as the minimum in-line flow rates are initiated within the allowable “zero flow” operation time.

2.03 UV LAMPS

A. Lamps shall be high-intensity medium pressure type with a 24-inch arc length and a maximum power input of 9.1 kW. The lamps shall be operated by variable output electronic ballasts with 1% power increments, from 30% to 100% of full rated output.

B. The filament shall be sufficiently rugged to withstand shock and vibration. The lamp bases shall be resistant to UV and ozone.

2.04 UV LAMP SLEEVES

Manufacture the UV lamp sleeves from Type O22, fully annealed, clear fused quartz tubing. Lamp sleeves shall be domed at one end. The open end of the lamp sleeve shall be sealed by means of an O-ring and Type 316 stainless steel compression plate.

2.05 UV INTENSITY SENSOR(S)

A. Locate the UV intensity sensor(s) inside the reactor within protective quartz sleeves. Provide one sensor per lamp.

B. Sensor(s) shall incorporate SiC diodes and provide NIST-traceable measurement with a total absolute uncertainty of 15% or less at an 80% confidence level. Sensor(s) shall meet the requirements of the EPA 815-R-06-007. Sensor(s) shall filter out wavelengths below 240 nm and have a spectral response peaking between 250 nm and 280 nm with less than 10% coming from wavelengths greater than 300 nm.

C. The complete sensor assembly and the internal circuit board containing the diode shall each be serialized.

2.06 BALLASTS

A. Each ballast shall supply power to one lamp only. Ballasts shall be of a high frequency output, fully electronic design with a minimum efficiency of 95% at full load and a power factor of 99% or better. Ballasts shall have a variable operation range of 30% to 100% of full rated output and be adjustable in 1% increments.

B. The maximum allowable total current harmonic distortion (current THD) shall not exceed 10% at the maximum power level.

C. Ballasts shall have a mean design life expectancy of at least 10 years.

2.07 CONTROL POWER PANEL

A. Power distribution and control for each UV reactor shall be through the associated control power panel. Design the control power panel to operate with the specified electrical supply. The control power panel shall house the power supplies and control hardware. The control power panel enclosure shall be epoxy painted carbon steel, NEMA Type 12, ventilated, with forced-air cooling.

B. Signal wiring interfacing the UV reactor with the control power panel shall be as shown in the drawings.

C. Provide each control power panel with a lockable disconnect handle that shall shut down the reactor/cabinet power when the cabinet door is opened.

2.08 CONTROL AND INSTRUMENTATION

A. General:

1. Provide one control power panel for each UV reactor. Control hardware and software for a given reactor shall be contained within the associated control power panel. Each UV reactor shall be controlled independently.

2. Each UV reactor shall be controlled by an Allen Bradley Compact Logix L35 which shall continuously monitor and control the UV reactor's functions. The electronics system, an input flow signal (supplied by others), and the UV sensor(s) shall provide the PLC with the necessary indications of system parameters.

3. Control of multiple reactors shall be accomplished through SCADA.

B. Operator Interface: Complete control and monitoring of each reactor shall be accomplished through the operator interface located on the control power panel. The operator interface shall be menu driven and shall display the following system information when prompted: reactor status, individual lamp status, lamp operating hours, RED (dose), UV intensity, power level, alarms, and alarm history. The most recent alarms shall be displayed on the operator interface when prompted and recorded by alarm type, date, and time of occurrence and date and time of correction. The operator interface shall be the Allen Bradley Panelview+ 700.

C. Remote Monitoring/Control:

1. The communication between the UV reactors and the plant control center shall be through the following protocol:

Allen Bradley – Ethernet

2. Each reactor shall be capable of being placed in either local or remote mode.

3. Provide each system with the following interface hardwired I/O:

a. Discrete input for reactor on/off control from remote location.

b. Discrete output indicating critical alarm.

c. Discrete output indicating major alarm.

d. Discrete output indicating minor alarm.

e. Discrete output indicating system ready.

f. Discrete on/off status.

g. 4- to 20-mA flow signal analog input.

h. 4- to 20-mA UV intensity analog output.

2.09 DOSE PACING

A. Provide a dose-pacing system to modulate the lamp power levels based on the flow rate, UV sensor signal(s), and UV transmission values according to the validation report.

B. The system shall be dose paced such that as the flow rate, water quality, and lamp conditions change, the UV RED (dose) target shall be achieved while conserving power.

2.10 SAFETY FEATURES

A. Provide each UV reactor with a temperature switch to prevent the reactor from overheating. The temperature switch shall be wired to the control power panel and shall shut down the reactor and initiate a critical alarm condition when activated.

B. Provide each UV reactor with a water level sensor to prevent operation of the UV lamps in air. The level sensor shall be wired to the control power panel and shall shut down the reactor and initiate a critical alarm condition if low water level is detected.

C. Provide each UV reactor with a cover to protect the lamp’s electrical connections. Provide the protective cover with a switch to disconnect power to the lamps when the cover is removed.

D. Provide each UV reactor with a pilot light indicating when the reactor and lamps are on.

E. Provide each UV reactor with a reactor-mounted junction box that provides separate access to high- and low-voltage circuits.

F. Provide each control power panel and reactor with an emergency stop button to shut off power to the lamps.

2.11 ON-LINE UV TRANSMISSION MONITOR

A. Provide an on-line UV transmission monitor to automatically monitor the UV transmission of the process stream (measured at 254 nm, 1-cm path length). The UV transmission monitor shall include a UV lamp, UV sensor, drive system, system controller, and operator interface. UV transmission range shall be 70% to 100%.

B. Power supply to the monitoring system shall be 120 volts, single phase, 60 Hz.

C. The operator interface shall display the system status and allow for manual on/off system control. Locate the operator interface system on the door of the enclosure. Enclosure shall be stainless steel, Type 4X.

D. Design the monitoring system to accommodate flow rates of 0.1 gpm (0.4 l/min.) to 0.5 gpm (2.0 l/min) at a maximum inlet pressure of 30 psi. Inlet/outlet fittings shall be 3/8-inch female for connection to process stream and drain. Supply tubing/piping shall be a maximum of 1/4-inch internal diameter. Provide flow regulators and/or pressure reducers to maintain specified minimum and maximum values.

E. Provide a 4- to 20-mA output for data transmission to remote devices. Provide a discrete common alarm for remote indication of alarm condition.

F. Monitoring panel shall be UL, CSA, and CE approved.

G. The process stream temperature range shall be 36°F to 104°F (2°C to 40°C).

H. The expected life of the lamp shall be 9,000 hours.

2.12 CLEANING SYSTEM

A. Provide each UV reactor with an automatic on-line sleeve cleaning system. If an automatic chemical/mechanical cleaning system is not furnished, the Contractor shall provide an additional reactor and related equipment to automatically clean the lamps while maintaining full flow capacity. The cleaning system shall be driven by a hermetically sealed magnetically coupled hydraulic drive. Design the drive system such that hydraulic connections are outside the UV reactor. The hydraulic fluid used shall be biodegradable.

B. The cleaning system shall provide both mechanical and chemical cleaning abilities for both the lamp sleeves and the UV sensor sleeves/windows, complete with an automatically initiated and controlled cleaning cycle. The cleaning system shall be fully operational while still providing disinfection.

C. Cleaning cycle intervals shall be field adjustable via the operator interface. Manual cleaning system control shall also be through the operator interface.

D. Provide the system with the cleaning reagents and solutions required for initial equipment testing and equipment start-up. Cleaning reagents and solutions used shall be NSF 60 approved.

PART 3 - EXECUTION

3.01 SERVICE CONDITIONS

Provide equipment which shall disinfect an effluent with the following characteristics:

UV Design Flow	20 gpm
Design Pressure	75 psi

3.02 INSTALLATION

A. Connect piping to the UV vessels after grouting, anchor bolt installation and attachment, and final field welding have been completed.

B. Do not install unsupported piping and conduits on the pressure vessels. Install piping and conduit hangers and supports as shown in the drawings to minimize piping-applied strain on the equipment.

C. Ensure that fluid passages of pressure vessels are free from dirt, foreign objects, and other contamination. Install temporary blinds at the flanges to prevent dirt and debris from entering them during installation. Plug threaded openings with a threaded pipe plug to prevent contamination. Do not use plastic piping plugs.

D. Do not use duct tape and plastic for covering the ends of pipe flanges. Use a solid metal cover with rubber gasket to cover flanged openings during installation. These metal covers shall remain in place until the piping is connected to the equipment.

3.03 FIELD TESTING

A. Perform field testing for 10 days on the installed system. Prepare and submit a report containing the following data:

1. Plant flow for each 24-hour period.

2. Peak hourly flow in the 24-hour testing period.

3. UV dosage produced.

4. System energy consumption for each 24-hour period.

5. Effluent coliform count for each 24-hour period.

END OF SECTION 32 84 10

SECTION 32 8420 - IRRIGATION PUMP

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation for the stainless steel vertical well type submersible pump

Submittals

A. Submit shop drawings in accordance with the General Conditions

B. Submit dimensional drawings.

C. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings.

D. Submit pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Show required submergence and NPSH.

PART 2 - MATERIALS

2.01 PUMP DESIGN

A. Equipment for the pumps, including motors, float switches, shall be provided as a complete unit by the pump manufacturer.

B. Impellers shall be dynamically balanced.

2.02 MATERIALS OF CONSTRUCTION

A. Pumps shall have the following materials of construction:

Component	Material	Specification
Motor housing, volute, head, shell, and mounting bracket	Stainless Steel	AISI Type 316
Shaft	Stainless steel	AISI Type 303 or 416
Shaft column	Stainless Steel	AISI Type 303 or 416
Impeller	Stainless Steel	AISI Type 316
Impeller cover	Stainless Steel	AISI Type 316
Exposed cap screws, nuts, and bolts	Stainless steel	AISI Type 316
Strainer	Stainless steel	AISI Type 316

2.03 SUBMERSIBLE PUMP

A. Submersible pump shall be stainless steel capable of passing a 1/2-inch sphere, with automatic start/stop operation, based on water level in the sump. Provide oil-filled motor chamber, internal mechanical seal, internal thermal overload protection, and float switch control.

B. Pump design point shall be 20 GPM and 75 PSI head.

C. Manufacturers and Models: Wayne, Goulds, Grundfos equal.

2.04 CONTROLS

A. Provide electrical panels per Section 26-2419

B. Provide NEMA 4X control panel with alternator circuit, UL listed. Provide HOA switch and run light, with audible alarm and test switch. Provide motor contactor and circuit breakers. Provide output contacts for the specified level alarms.

C. Provide float-actuated switches to start and stop the pumps.

3.01 SHIPMENT AND STORAGE

A. Prepare equipment for shipment including blocking of the rotor when necessary. Identify blocked rotors by means of corrosion-resistant tags attached with stainless steel wire.

B. Identify the equipment with item and serial numbers. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

C. Pack and ship one copy of the manufacturer’s standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

D. Coat exterior machined surfaces with a rust preventative.

E. The interior of the equipment shall be clean and free from scale, welding spatter, and foreign objects.

F. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of pump manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

G. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of pump manufacture prior to shipping.

END OF SECTION 32 84 20

SECTION 32 91 13 — PLANTING SOIL PREPARATION AND PLANTING SOIL MIX DESIGNS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. In-Place Amendment of Planting Area Soil Surfaces.
2. Plant Pit Backfill Mix.

B. Related Sections:

1. Section 32 01 90, Landscape Maintenance Period.
2. Section 32 84 00, Planting Irrigation.
3. Section 32 91 19, Planting Area Finish Grading.
4. Section 32 93 00, Planting Materials.

1.2 REFERENCES

A. ASTM — ASTM International: D 1557 — Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

B. USDA — United States Department of Agriculture:

1. Soil Texture Triangle Classification.
2. Handbook No. 60.

1.3 DEFINITIONS

A. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

B. Excessive Compaction: Planting area soil compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

C. Horticultural Consultant: Horticultural consultant employed by Landscape Architect for Project.

D. Landscape Architect: Landscape Architect employed by the Owner to provide professional landscape architectural services for the Project.

E. Drip Line: Line straight down from outermost limit of tree canopy branching.

1.4 SYSTEM DESCRIPTION

A. Backfill Mixes and Amended Planting Area Surface Soil: Uncompacted on-site soil with amendments incorporated uniformly to provide a well-draining, fertile medium for vigorous plant root growth.

B. Soil Mixes: Uncompacted, imported topsoil with amendment incorporated uniformly to provide a well-draining, fertile medium for vigorous plant root growth.

1.5 SUBMITTALS

A. General Requirements: Refer to Division 1.

B. Product Data:

1. Chemical Amendments.
2. Organic Soil Conditioner.
3. Fertilizers.
4. Polymeric Soil Conditioner.
5. Organic Amendment.
6. Coco Peat.

C. Test Reports:

1. Laboratory soil test reports indicating specified characteristics of soil, with test date no more than 2 weeks old.
2. Laboratory soil test reports.
3. Laboratory test report of organic amendment indicating specified characteristics of organic amendment, with test date no more than 2 weeks old.
4. Sieve analysis of sand for sodded lawn planting mix with test date no more than 2 weeks old.
5. Sieve analysis of sand for palm tree plant pit backfill mix.

D. Purchase Documentation:

1. Fertilizer Purchase and Delivery Invoices.
2. Chemical Amendment Purchase and Delivery Invoices.

1.6 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.

B. Agronomic Testing Agency:

1. Send samples to Wallace Laboratories, 365 Coral Circle, El Segundo, CA 90245, and employ the laboratory to test the soil mixes and import soils.

C. Settlement Mock-Up:

1. Mock-up areas of backfill mix at the specified depths and apply irrigation to induce settlement, to help determine the amount of settlement which will be caused by irrigation and rain.
2. Use settlement observed in mock-up to help determine allowances to make for settlement as required by this Section and other Sections.

1.7 SITE CONDITIONS

A. Environmental Requirements:

1. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.
2. Apply water, if necessary, to bring soil to an optimum moisture content for tilling.
3. Do not work soil when muddy or frozen.
4. Do not apply chemicals if wind conditions will cause hazardous drift to people or property.

B. Existing Conditions:

1. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing public underground utilities and structures with respective utility companies.
2. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing private underground utilities and structures with the Owner's Designated Representative.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

A. Fertilizers:

1. Roots, Inc., Independence, Mo.; (800) 342-6173; www.rootsinc.com.
2. Vermi Technology Unlimited, Orange Lake, Fla; (352) 591-1111; www.vermitechnology.com.
3. Kelly's Green Team, Newark, Mo.; (660) 627-5500; www.kellysgreenteam.com.

2.2 MATERIALS

A. Import Top Soil: Import top soil shall be classified as sandy loam, and must conform to the following:

1. Particle size

Class	Particle Size Range	Maximum %	Minimum %
Coarse sand	0.5 - 2.0mm	15	0
Silt plus clay	<0.05mm	50	15
Other classes:			
Gravel	2-13mm	15	0
Rock	1/2 - 1”	5% by volume with none > 1”	

2. Chemistry

a. Salinity: Saturation Extract Conductivity (ECe) - less than 3.0 sD/m @ 25° C

b. Sodium: Sodium Absorption Ratio (SAR) - less than 6.0

c. Boron: Saturation Extract Concentration - Less than 1.0 ppm

d. Reaction: pH of Saturated Paste - 5.5-7.8 without high lime content

3. Soil shall contain sufficient quantities of available nitrogen, phosphorus, potassium, calcium and magnesium to support normal plant grown. In the even t of nutrient inadequacies, provisions shall be made to add required material prior to planting.
4. In order to insure conformance, samples of the import soil shall be submitted to an approved laboratory for analysis prior to and following backfilling.
5. Obtain imported topsoil from approved local sources.

A. Organic Amendment:

1. Humus material shall have an acid-soluble ash content of no less than 5 percent and no more than 20 percent.
2. The pH of the material shall be between 6 and 7.5.
3. The salt content shall be less than 10 millimho/cm at 25 degrees C on a saturated paste extract.
4. Boron content of the saturated extract shall be less than 1.0 part per million
5. Silicon content (acid-insoluble ash) shall be less than 50 percent.
6. Calcium carbonate shall not be present if the amendment is to be applied on alkaline soils.
7. Types of acceptable products are composts, manures, mushroom composts, straw, alfalfa, peat mosses, etc., low in salts, low in heavy metals, free from weed seeds, free of pathogens and other deleterious materials.
8. Composted wood products are conditionally acceptable (stable humus must be present). Wood-based products are not acceptable which are based on redwood or cedar.

9. Sludge-based materials are not acceptable.
10. Carbon-nitrogen ratio shall be less than 25:1.
11. The compost shall be aerobic without malodorous presence of decomposition products.
12. The maximum particle size shall be 0.5-inch and 80 percent or more shall pass a No. 4 screen for mixing with soil. The maximum particle size for applying via hydroseeding machine shall be 0.25-inch.
13. Maximum total permissible pollutant concentrations in organic amendment in parts per million on a dry-weight basis:

Arsenic:	20
Cadmium:	15
Chromium:	300
Cobalt:	50
Copper:	150
Lead:	200
Mercury:	10
Molybdenum:	20
Nickel:	100
Selenium:	50
Silver:	10
Vanadium:	400
Zinc:	250

Higher amounts of salinity or boron may be present if the soils are to be pre-leached to reduce the excess or if the plant species will tolerate the salinity and/or boron.

14. From 45- to 65-percent moisture measured via wet-weight basis.
15. Free of stones and debris.
16. Tests 5 to 8 on Solvita Test.

B. Fertilizers:

1. Roots “M-Roots” with mycorrhiza 3-3-3.
2. Kelley’s Green Team Gypsum Fairway Pellets, 76-percent calcium sulphate dehydrate, 17-percent calcium; 14-percent sulphur, derived from mined gypsum, less than 1-percent moisture content.
3. Vermi Technology pure black worm castings produced without waste products; free of larva, sticks, stones, and debris; 48 percent by weight minimum organic content per ASTM D2974; complying with the following:

Item	*Criteria*
Total Ash	48% to 52%
pH:	5.0 to 7.5
% Moisture (wet wt. basis:	30% to 50%
Solvita Rating:	> 8

C. Potential Chemical Amendments Required by Accepted Amendment Program and Backfill Mix:

1. Ground Limestone: Agricultural limestone containing not less than 85 percent of total carbonate, ground to such fineness that 50 percent will pass No. l sieve and 90 percent will pass No. 20 sieve.
2. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35 percent minimum magnesium carbonate and 49 percent minimum calcium carbonate, 100 percent passing No. 65 sieve.
3. Gypsum: Agricultural grade product containing 80 percent minimum calcium sulfate.
4. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20 to 30 percent iron and 35 percent to 40 percent sulfur.
5. Sulfate of Potash: Agricultural grade containing 50 to 53 percent of water-soluble potash.
6. Single Superphosphate: Commercial product containing 20 to 25 percent available phosphoric acid.
7. Ammonium Sulfate: Commercial product containing approximately 21 percent ammonia.
8. Ammonium Nitrate: Commercial product containing approximately 34 percent ammonia.
9. Calcium Nitrate: Agricultural grade containing 15-1/2 percent nitrogen.
10. Urea Formaldehyde: Granular commercial product containing 38 percent nitrogen.
11. IBDU (Iso Butyldiene Diurea): Commercial product containing 31 percent nitrogen.
12. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96 percent sulfur.
13. Silicic Acid Calcium: Commercial grade.

D. Polymeric Soil Conditioner: Twenty to 25 percent anionic polyacrylamide, water-soluble, linear, 7,500,000-dalton, soil aggregating polymer containing a minimum of 20,000 soil binding sites proven to be efficacious.

2.3 MIXES

A. Preliminary Plant Pit Backfill and Shrub Import Profile Mix for interior courtyard to Establish Bid (actual quantities contingent on amendment program determined by the Landscape Architect and Horticultural Consultant based on soil test report):

1. Content:
   a. 8 cubic feet of organic amendment per cubic yard of dry import top soil.
   b. 1-pound dry polymeric soil conditioner per cubic yard of dry soil.
   c. 2 pounds Iron Sulfate per cubic yard of dry soil.
   d. 1-pound granular Micromax per cubic yard of dry soil.
   e. 1/2-pound Triple Superphosphate 0-45-0 per cubic yard of dry soil.
   f. 1-pound of Nitroform 38-0-0 per cubic yard dry soil.
   g. 1-pound of Potassium Sulfate 0-0-50 per cubic yard dry soil.

2. Mixing:
   a. Blend materials uniformly with 50 percent dry existing soil excavated from plant pits and 50 percent dry imported topsoil in bulk by turning over materials with an end loader.

b. Blend materials in a clean area which will not contaminate mix.
c. Do not mix in planting areas.

B. Final Plant Pit Backfill Mix for Installation: Backfill mixes determined by the Landscape Architect and Horticultural Consultant upon review of the soil test report.

C. Preliminary In-Place Amendment of Planting Area Surfaces to Establish Bid (actual quantities contingent on amendment program determined by the Landscape Architect and Horticultural Consultant based on soil test report):

D. Final In-Place Amendment of Planting Area Surfaces: Determined by the Landscape Architect and Horticultural Consultant upon review of the soil test report.

2.4 SOURCE QUALITY CONTROL

A. Organic Amendment: Employ independent soil testing laboratory to test organic amendment for specified properties and submit test results.

PART 3 EXECUTION

3.1 EXAMINATION

A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

B. Subgrade: Verify that the subgrade is at the correct elevation and slope.

C. Underground Utilities and Structures: Verify that the locations of utilities, structures and other underground items have been clearly marked.

D. Notification of Unsuitable Conditions: Before proceeding with Work, notify the Owner's Designated Representative in writing of unsuitable conditions and conflicts.

E. Soil Tests to Determine Final Plant Pit Backfill Mix, Planting Area Soil Surface Amendment Programs, and Maintenance Period Fertilization Programs:

1. Take fifteen 1-pound composite representative soil samples from locations determined by the Architect/Engineer in the field.
2. Send samples to Wallace Laboratories, 365 Coral Circle, El Segundo, CA 90245, and employ the laboratory to test the soil samples for the following:
   a. pH measurement in the saturation extract per USDA Handbook No. 60, Method 21.
   b. Electrical conductivity of the saturation extract per USDA Handbook No. 60, Method 2.
   c. Sodium absorption ratio of the saturation extract per USDA Handbook No. 60, Method 20b.

d. Determination of boron, calcium, copper, iron, magnesium, manganese, molybdenum, phosphorous, potassium, sodium, sulfur, and zinc, via the following test methods: Mehlich Number 3, Bray P1, Bray P2, Olsen P, DTPA, ammonium acetate, ammonium bicarbonate DTPA, and hot water extract from boron.
e. Analysis of saturation extract for calcium, magnesium, sodium, boron, chloride, phosphorous, nitrate, and sulfate.
f. Measurement of following trace metals by the DTPA extract: aluminum, arsenic, cadmium, chromium, cobalt, lead, lithium, nickel, selenium, silver, strontium, tin, and vanadium.
g. Presence of calcium carbonate and magnesium carbonate.
h. Estimate of soil texture per commonly used methods.
i. Estimate of organic matter content per commonly used methods.
j. Exchangeable Ammonium Cation.
k. Base Saturation.
l. Cation Exchange Capacity.
m. Carbonates Determination.
n. Soil Bulk Density.
o. Water Infiltration Rate per USDA Handbook No. 60, Method 34b.

3. At least 30 days prior to commencement of soil preparation Work, submit to the Architect/Engineer and Horticultural Consultant the laboratory's written soil test report including the laboratory's soil test data; the laboratory's interpretation of nutritional deficiencies, excesses, and potential toxicities; the laboratory's amendment recommendations; and the laboratory's maintenance recommendations.
4. The Architect/Engineer and Horticultural Consultant will determine the final amendment and maintenance period fertilization programs based on the soil test report which may differ from the soil test report amendment recommendations.

F. Soil Tests for Parasitic Nematodes:

1. Test soils which have been used for agricultural purposes within the prior 12 months for parasitic nematodes.
2. Soil will be acceptable if the parasitic nematode population is less than 200 per 50 cubic centimeters of soil.
3. Do not artificially dry soil prior to testing.
4. Submit written test report to the Architect/Engineer and Horticultural Consultant.

G. Soil Tests for Herbicide Contamination:

1. Perform a radish/rye grass growth trial on soils suspected of herbicide contamination.
2. Submit written test report to the Architect/Engineer and Horticultural Consultant.

3.2 WEED ERADICATION PROGRAM OF EXISTING VEGETATION AT PLANTING AREAS

A. Six weeks prior to planting and before tilling or amending planting areas, spray existing vegetation with 3 percent Glyphosate solution and repeat treatment 3 weeks later to kill re-emerging vegetation.

3.3 PREPARATION OF IN-PLACE TOPSOIL AREAS FOR CONTAMINATED SOILS AREAS AS DETERMINED BY TESTING

A. Protection:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
2. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
3. Provide barricades, fences or other barriers to protect existing conditions to remain from damage and excessive compaction during construction.
4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
5. Submit written notification of conditions damaged during construction to the Owner's Designated Representative immediately.

B. Tilling: After ripping, uniformly till soil surface to a 6 to 8-inch depth using a rototiller or other accepted tilling implement.

C. Cleaning Soil Surface: After tilling soil surface, clear soil surface of surface stones larger than 1 inch, debris, roots, branches, sticks, contaminated soil, and other extraneous materials.

3.4 PREPARATION OF SUBGRADE TO RECEIVE IMPORTED SOIL MIXES

A. Protection:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
2. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
3. Provide barricades, fences or other barriers to protect existing conditions to remain from damage and excessive compaction during construction.
4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
5. Submit written notification of conditions damaged during construction to the Owner's Designated Representative immediately.

B. Ripping Subgrade Soil:

1. Prior to placing topsoil, rip areas to receive topsoil on the same day topsoil is placed.
2. Rip subgrade twice to a depth of **6** inches unless indicated otherwise.
3. Space ripping tines at 24 inches on center.
4. Make second ripping pass in a direction 90 degrees to the direction of the first ripping pass.
5. Do not rip closer than 2 feet horizontally and vertically to installed and existing utility lines and structures.

C. Location and Depths: As indicated on the Drawings.

D. Topsoil Placement:

1. Place topsoil same day that subgrade soil ripping occurs and prior to vehicle or equipment traffic running over the ripped surface.
2. Place topsoil with equipment of appropriate size for area and in a manner that avoids excessive compaction of the topsoil.
3. Avoid repeatedly driving equipment in same tracks so that topsoil does not become excessively compacted.

E. Allowances: Place topsoil to elevations that allow for settlement, addition of soil amendment, and finish grading tolerances.

F. Topsoil Finished Grade: See Section 32 91 19.

G. Surface Drainage: Keep topsoil surface sloped so that surface drains.

H. Compaction and Contamination:

1. In handling materials and operating tools and equipment, protect the topsoil from excessive compaction by laying down planks, plywood, or other accepted protective devices.
2. Do not store or stockpile materials on the topsoil.
3. Do not allow vehicles to park or drive on topsoil, except equipment which is preparing and finish grading the soil.
4. If ruts are formed, blade rutted topsoil smooth.
5. Loosen excessively compacted soil to the full depth of the excessive compaction, rototill, and grade surface smooth.

I. Excessively Compacted Topsoil:

1. Mechanically loosen excessively compacted topsoil to its full depth via a method acceptable to the Landscape Architect and re-grade surface smooth.
2. Keep topsoil from being excessively compacted until date of Final Completion.

J. Erosion Repair:

1. Repair erosion that occurs between topsoil installation and plant or seed installation.
2. Fill eroded areas with topsoil and finish grade.

3.5 PREPARATION OF SOIL SURFACE OF PLANTING AREAS

A. Protection of Existing Conditions:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
2. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.

3. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
5. Submit written notification of damaged plants and structures to the Owner's Designated Representative immediately.

B. Surface Preparation:

1. Inspect soil surface for sticks, oils, chemicals, plaster, concrete, and other deleterious materials.
2. Do Work required to remove and dispose of the deleterious materials.

C. Excessively Compacted Areas:

1. Where tilled planting soil or imported planting soils have become compacted more than 75-percent maximum dry density per ASTM D 1557 rip soil to 4 inches below the depth of the excessive compaction.
2. Space ripping tines at 18 inches on center.

3.6 AMENDMENT OF SOIL SURFACE OF PLANTING AREAS

A. Preliminary Amendment Program to Establish Bid for Areas Within Drip Lines of Existing Trees to Remain in Planting Areas Not to Receive Topsoil: 3 cubic yards of organic amendment per 1,000 square feet, 10 pounds of granular Micromax per 1,000 square feet, 9 pounds of Nitroform 38-0-0 per thousand square feet, and 2.5 pounds of Triple Superphosphate 0-45-0 per thousand square feet.

B. Preliminary Amendment Program to Establish Bid for Areas with Imported Topsoil: 6 cubic yards of organic amendment per 1,000 square feet, 25 pounds of polymeric soil conditioner per 1,000 square feet, 40 pounds Iron Sulfate per 1,000 square feet, 20 pounds of granular Micromax per 1,000 square feet, 20 pounds of Nitroform 38-0-0 per 1,000 square feet, 10 pounds of Potassium Sulfate 0-0-50 per 1,000 square feet, and 5 pounds of Triple Superphosphate 0-45-0 per 1,000 square feet.

C. Final Amendment Programs for Installation: Determined by Architect/Engineer and Horticultural Consultant based on soil test report results.

D. Amendment Incorporation:

1. Spread dry amendments evenly over surface of dry soil with a drop spreader.
2. Organic amendment and soil must be dry.
3. Incorporate amendments uniformly within top 6 to 8 inches of soil within a few hours after amendment application, except at areas within drip lines of existing trees to remain.
4. At areas within drip lines of existing trees to remain, incorporate amendments uniformly to 1 to 2-inch depth within a few hours after application.
5. Mechanically incorporate the amendments into the soil via a method that will not excessively compact the soil below incorporated amendments.

6. To activate polymeric conditioner, irrigate soil very slowly so that soil surface will not form a crust and until water penetrates 6-inch depth.
7. Allow soil to dry until stringiness disappears.
8. Prior to planting, re-till soil to a 6-inch depth at areas outside of drip lines of existing trees to remain and re-till soil to a 1 to 2-inch depth at areas within drip lines of existing trees to remain.

3.7 FIELD QUALITY CONTROL

A. Soil Amendment Verification:

1. Schedule Horticultural Consultant to take up to 4 random composite samples of amended soil surface areas and soil mixes for laboratory testing to verify amendment composition.
2. Submit composite samples collected by the Horticultural Consultant to the same soil testing laboratory used to test the soil as indicated in Article 3.1 E of this Section.
3. Employ the laboratory to test soil samples and submit test results to Horticultural Consultant and Architect/Engineer.
4. Perform corrective work as recommended by the laboratory soil test reports if directed to do so by the Architect/Engineer.
5. When a laboratory soil test indicates that the soil or soil mixes meet the requirements of the Specifications the Contractor will receive written notification of acceptance from the Architect/Engineer.
6. Installation of ground cover plants and seed may commence upon Contractor’s receipt of the written notification of acceptance.

END OF SECTION

SECTION 32 9119 -FINISH GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work includes: weeding and finish grading of lawn and planting areas.

B. Related work:

1. Section 32 13 13: Concrete Paving.

2. Section 32 84 00: Landscape Irrigation.

3. Section 32 90 00: Planting Materials.

4. Section 32 91 13 Planting Soil Preparation and Planting Soil Mix Designs.

1.2 DEFINITIONS:

A. Finish grading: finish grading shall consist of adjusting and finishing soil surfaces with site or imported topsoil, raking grades to a smooth, even, uniform plane. Remove and legally dispose of all extraneous matter off site. Facilitate natural run-off water and establish grades and drainage indicated as part of the contract work.

B. The word Architect as used herein shall refer to the Landscape Architect or the Owner's authorized representative.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Import Top Soil: Import top soil shall be classified as sandy loam, and must conform to the following:

1. Particle size

Class	Particle Size Range	Maximum %	Minimum %
Coarse sand	0.5 - 2.0mm	15	0
Silt plus clay	<0.05mm	50	15
Other classes:			
Gravel	2-13mm	15	0
Rock	1/2 - 1”	5% by volume with none > 1”	

2. Chemistry

a. Salinity: Saturation Extract Conductivity (ECe) - less than 3.0 sD/m @ 25° C

b. Sodium: Sodium Absorption Ratio (SAR) - less than 6.0

c. Boron: Saturation Extract Concentration - Less than 1.0 ppm

d. Reaction: pH of Saturated Paste - 5.5-7.8 without high lime content

3. Soil shall contain sufficient quantities of available nitrogen, phosphorus, potassium, calcium and magnesium to support normal plant grown. In the even t of nutrient inadequacies, provisions shall be made to add required material prior to planting.

B. In order to insure conformance, samples of the import soil shall be submitted to an approved laboratory for analysis prior to and following backfilling.

C. Obtain imported topsoil from approved local sources.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verification of conditions: Prior to commencing the finish grading, review the installed work of other trades and verify that their work is complete.

1. Rough Grading: Grading in planting areas (except raised planter areas) shall be established to within plus or minus 0.10 foot prior to beginning of finish grading.

2. Moving onto the site and/or commencing work shall be construed as acceptance of rough grade conditions by the Contractor.

B. Import topsoil only when necessary to supplement site soil to achieve grades shown on Drawings, or if site soil is unsuitable for planting.

3.2 PREPARATION:

A. Weeding: Before finish grading, weeds and grasses shall be dug out by the root or sprayed with an herbicide and disposed of off-site. This procedure is outlined under the Landscape Planting Section.

B. Debris: Remove stones and debris 1 inch in diameter and greater and clumps of earth that do not break up. Dispose of off-site.

3.3 INSTALLATION:

A. General: When rough grading and weeding have been completed, and the soil has dried sufficiently to be readily worked, lawn and planting areas shall be graded to the elevations indicated on the Drawings.

1. Grades indicated on Drawing are grades that will result after thorough settlement and compaction of the soil.

2. Grades not otherwise indicated shall be uniform finish grades and, if required, shall be made at the direction of the Architect.

3. Finish grades shall be smooth, even, and a uniform plane with no abrupt change of surfaces.

4. Soil areas adjacent to buildings shall slope away from the building to allow a natural run-off of water, and surface drainage shall be directed as indicated on the drawings by remodeling surfaces to facilitate the run off water at 2% minimum grade.

5. Low spots and pockets shall be graded to drain properly.

B. Drainage: Finish grade with proper slope to drains.

1. Flow lines, designated or not, shall be graded and maintained to allow free flow of surface water.

2. If any drainage problems arise during construction period due to Contractor's work (such as, but not limited to, low spots, slides, gullies and general erosion), the Contractor shall be responsible for repairing these areas to a condition equal to their original condition, and in so doing shall prevent further drainage problems from occurring.

C. Toe of slope: To prevent soil creep or erosion across pavement, where pavement (walk, curb, etc.) is at the toe of a slope, finish grade is to level out or swale slightly at least 6” before reaching pavement

D. Moisture Content: The soil shall not be worked when the moisture content is so great that excessive compaction occurs, nor when it is so dry that dust may form in the air or that clods do not break readily. Water may be applied, if necessary, to provide moisture content for tilling and planting operations. It is the Contractor’s responsibility to control dust that is spread as a result of grading operations.

E. Grades: The finish grade shall be 1-1/2 inch below grade of adjacent pavement, walks, curbs, or headers except when drainage conditions require flush grades, as directed by the Owner's Representative, or if otherwise indicated on Drawings.

F. Compaction: Soils in planted areas shall be loose and friable, yet firm enough that no settling occurs from normal foot traffic or irrigation.

3.4 FIELD OBSERVATION:

A. Contact the Architect 48 hours or two working days in advance of each agreed observation or conference.

B. Schedule for On-Site Reviews: At completion of finish grading and prior to any planting operations.

END OF SECTION

SECTION 32 9300 - PLANTING MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trees.
2. Shrubs.
3. Ground Cover.
4. Wood Chip Mulch.
5. Tree Stakes.
6. Root Barrier.
7. Root Ball Anchor Systems.
8. Palm Trees.

B. Related Sections:

1. Section 32 01 90, Landscape Maintenance Period.
2. Section 32 84 00, Irrigation.
3. Section 32 91 13, Planting Soil Preparation and Soil Mix Design.

1.2 REFERENCES

A. ANSI — American National Standards Institute: Z60.1 — American Standard for Nursery Stock, Current Edition.

B. ICBN — International Code of Botanical Nomenclature.

C. ICNCP — International Code of Nomenclature of Cultivated Plants.

D. ASTM — American Society for Testing Materials: D 1557 — Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.3 DEFINITIONS

A. Plant Height: Measurement of main body height, not measurement to top branch tip.

B. Plant Spread: Measurement of main body diameter, not measurement from branch tip to tip.

C. Caliper: Trunk diameter measured at a point 6 inches above natural ground surface for trees up to 4 inches in caliper, and measured at a point 12 inches above natural ground surface for trees over 4 inches in caliper.

D. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

E. Excessive Compaction: Planting area soil compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

1.4 ACTION SUBMITTALS

A. General Submittal Requirements: Refer to Division 1.

B. Product Data:

1. Tree Ties.
2. Root Barrier.
3. Wood Pole Tree Stakes.
4. Fertilizers.
5. Fertilizer for Palm Trees.
6. Fungicide for Palm Trees.

C. Samples:

1. Wood Chip Mulch — 1/2-pound bag.
2. Tree Tie — 1 tie.

1.5 INFORMATIONAL SUBMITTALS

A. General Submittal Requirements: Refer to Section 32 01 90.

B. Contract Grow Requirements: Refer to Section 32 92 10.

C. Plant Material Location Data:

1. At 60 days after award of contract submit of plant material location data.
2. Quantities and sizes of each plant material type at each nursery or other place of growth.
3. Address, phone number, and contact person for each nursery or other place of growth.

D. Plant Material Photographs:

1. At 15 days after material location submittal data submit three color photographs each of representative plants of each type of plant material.
2. Include a scale object in each photograph such as a tape measure or person.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.

2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.

B. Tree Staking System Mock-Up:

1. Prepare mock-up of wood pole staking system.
2. Construct mock-up using specified materials.
3. Accepted mock-up shall be project standard by which Work will be judged.

C. Root Ball Anchor System Mock-up:

1. Prepare mock-up of root ball anchoring kit in accordance with the manufacturer's current printed installation instructions.
2. Accepted mock-up shall be Project standard by which Work will be judged.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handling Plants:

1. Do not lift or handle container plants by tops, stems or trunks.
2. Do not bind or handle plants with wire or rope.
3. Pad trunk and branches where hoisting cables or straps contact.

B. Digging Plants: Dig ball and burlap plants with firm, natural balls of earth of diameter meeting or exceeding requirements of ANSI Z60.1 and of sufficient depth as required to include the fibrous and feeding roots.

C. Plant Storage Prior to Installation:

1. Protect plant root balls from sun and drying winds.
2. Keep root balls moist.
3. Keep sun-sensitive plants shaded.
4. Anchor plants to prevent damage from strong winds.

D. Packaged Materials:

1. Deliver in original unopened factory containers with original labels intact and legible indicating the guaranteed chemical analysis.
2. Meet manufacturer's requirements for storage and protection of materials on-site.

E. Purchase Documentation: Fertilizer Purchase and Delivery Invoices.

1.8 SITE CONDITIONS

A. Environmental Requirements: Protect plant material being stored on site from sun and drying winds.

B. Existing Conditions:

1. Prior to Work commencement, review and clearly mark in field horizontal and vertical locations of public existing underground utilities and structures with respective utility companies.
2. Prior to Work commencement, review and clearly mark in field horizontal and vertical locations of private underground utilities and structures with the Owner's Representative.

1.9 WARRANTY

A. Warranty Period: Warrant that plant material will be healthy and in vigorous, flourishing condition of active growth one year from date of Final Completion.

B. Delays: Delays in completion of planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.

C. Condition of Plants: Plants shall be free of dead or dying branches and branch tips, with foliage of a normal density, size and color.

D. Incorrect Materials:

1. During Warranty Period, replace at no additional cost to the Owner, plants revealed as being untrue to name.
2. Provide replacements of a size and quality to match the planted materials at the time the mistake is discovered.

E. Replacements:

1. As soon as weather and seasonal conditions permit, replace at no additional cost to the Owner, dead plants and plants not in a vigorous, thriving condition, as determined by the Owner's Arborist during and at the end of Warranty Period.
2. Apply requirements of this Section to replacements.

1.10 MAINTENANCE

A. Maintenance Service: Refer to Section 32 01 90.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND SUPPLIERS

1. Wood Chip Mulch: Forest Floor 1-2" by Aguinaga Fertilizer Company, (949) 786-9558.

A. Fertilizers: Vermitechnology Unlimited, Orange Lake, FL; (352) 591-1111; www.vermitechnology.com.

B. Fertilizer for Palm Trees: Vermitechnology Unlimited, Orange Lake, FL; (352) 591-1111; www.vermitechnology.com.

C. Fungicides for Palm Trees:

1. Frond Application: W.A. Cleary Chemical; (800) 524-1162
2. Fungicide Soil Drench: Novartis; (910) 632-7208.

D. Root Ball Anchor System Kits: Laconia Earth Anchors, Inc., Nashua, NH; (877) 603-0237; www.laconiaearthanchors.com.

E. Root Barrier: Deep Root Partners, L.P., San Francisco, CA; (800) 458-7668; www.deeproot.com.

F. Mycorrhizal fungi shall be added in all planting areas, regardless of Soils Report. Mycorrhizal inoculum consists of a combination of :

1. Innoculum shall contain a blend of eight top types of Endospores: Glomus aggregatum, G. clarum, G. deserticola, G. intraradices, G. monosporus, G. mosseae, Gigaspora margarita, and Paraglomus brasilianum, and seven top types of Ecto fungi spores:Lacarria laccata, Pisolithus tinctorius, Rhizopogon amylpogon, R. fulvigleba, R. rubescens, R. villosuli, and Scleroderma spp. The guaranteed Endo spore count shall be a minimum 50 spores/cc, and the Ecto spore count shall be a minimum 50,000 spores/cc

2. Manufacturers:

a. BioOrganics Mycorrhizae Inoculants, (888) 332-7676

b. Mycorrhizal Applications, Inc, (866) 476-7800

c. Or equal.

2.2 SUBSTITUTIONS

A. Plant Material: Accepted substitute plants shall be true to species and variety and shall meet requirements of this Section except that plants larger than specified may be used, if accepted by the Landscape Architect, and at no additional cost to the Owner.

2.3 MATERIALS

A. General Plant Requirements:

1. Growing Practices: Nursery grown in accordance with best horticultural industry practices.
2. Nomenclature: Plant nomenclature shall meet requirements of ICBN and ICNCP.
3. Climatic Growing Conditions: Grown under climatic conditions similar to those of project for at least two years unless otherwise accepted by the Landscape Architect.
4. Container Growth Limitations: Container stock excluding annuals shall have been grown in the containers in which delivered for at least six months, but not over two years.
5. Root Ball Size: Meet or exceed requirements of ANSI Z60.1.
6. Branching: Structurally strong, able to stand upright without stakes or guys on a windless day; exceptionally heavy, symmetrical, tightly knit, so trained or favored in

development and appearance as to be superior in form, number of branches, compactness and symmetry.
7. Vigor: Sound, healthy and vigorous, well branched and densely foliated when in leaf.
8. Disease and Pests: Free of disease, insect pests, eggs, or larvae.
9. Root System: Healthy well-developed root systems, free of kinked, circling, girdling and center roots, root-bound condition and cracked or broken root balls.
10. Plant Size: Measure plants when branches are in their normal upright position.
11. Pruning: Do not prune, thin or shape plants before delivery without acceptance by the Landscape Architect.
12. Unacceptable Conditions: Multiple leaders, unless specified, damaged or crooked leaders, bark abrasions, sunscald, disfiguring knots, or fresh cuts of limbs over 3/4-inch diameter which have not completely callused.

B. Water: Clean, fresh, potable and free of toxic elements.

C. Wood Chip Mulch for Shrub and Ground Cover Areas: Grover Arbor Mulch.

D. Anti-Desiccant: Commercially available spray protective coating, designed to reduce plant transpiration loss, which produces a moisture retarding barrier not removable by rain or snow.

E. Wood Pole Tree Stakes: Pine round poles with 10-inch tapered driving point and chamfered top, un-treated pine or fir.

F. Tree Ties: Original Treestrap Biodegradeable Cotton (800) 360-3584.

G. Bolts, Lock Washers and Nuts: Hot-dip galvanized steel.

H. Root Barrier: Deeproot UB 18-2, or accepted substitute.

I. Fertilizers:

1. Vermitechnology Nutri-Sorb Biofertilizer plus natural water absorbing polymer. Nitrogen and water fixing organic fertilizer with mycorrhizae.
2. Vermitechnology - VermaPlex soil microbial activator.

J. Fertilizer for Palm Trees: Vermitechnology – Palm Perfection biofertilizer.

K. Fungicides for Palm Trees:

1. Palm Frond Application: W.A. Cleary Chemical "3336WP".
2. Fungicide Soil Drench: Novartis "Subdue".

L. Frond Tie: Minimum 1/2-inch diameter soft sisal rope. Use no wire.

M. Tree Root Ball Anchor Systems:

1. Laconia 13/RBS-HD kit for trees under 3 inches caliper.
2. Laconia 36/RBS-HD kit for trees 3 inches to 6 inches caliper.
3. Laconia 610/RBS-HD kit for trees over 6 inches caliper.

2.4 MIXES

A. Tree Plant Pit Backfill Mixes: Refer to Section 32 91 13.

B. On-Structure Soil Mix: Refer to Section 32 91 13.

C. Palm Backfill Mix: Refer to Section 32 91 13.

D. Desert Garden Soil Mix: Refer to Section 32 91 13

E. Polymeric Soil Conditioner-water Mix:

1. Mix dry polymeric soil conditioner with water at 0.04% concentration which equals 1/2-cup of dry soil conditioner per 30-gallon container.
2. While filling container with water, slowly pour dry soil conditioner into water stream to disperse particles.
3. Agitate container for 5 to 10 minutes until conditioner is completely dissolved.

2.5 SOURCE QUALITY CONTROL

A. Advanced Tree Procurement:

1. Within 30 days of award of Contract, notify Landscape Architect in writing of the availability or lack thereof of the specified plant material.
2. Procure trees and arrange for contract growing as required to ensure that plant material is available in the quantities and sizes specified, and of the quality specified, at time of installation.
3. Verify plant branching requirements with Landscape Architect prior to contract growing.
4. Landscape Architect will review advanced procured trees prior to initial purchase and at end of the first growing season.
5. Prior to delivery of advanced procured plant material to site, coordinate and schedule a final review of the plant material at the place of growth.
6. Review and acceptance of the advance-procured plant material at the place of growth does not cancel the right of the Landscape Architect to reject plant material at the site, if damage or unacceptable conditions are found that were not detected at the place of growth.

B. Plant Material Review and Tagging:

1. Trees will be reviewed, photographed and tagged using irremovable tags by the Landscape Architect at the nursery, or other place of growth prior to delivery of trees to site.
2. At the Landscape Architect’s discretion, shrubs may or may not be reviewed, photographed, and tagged by the Landscape Architect at the nursery or other place of growth.
3. Tagging of plant material at the nursery or place of growth does not affect the right of the Landscape Architect to reject plant material at the site, if damage or unacceptable conditions are found that were not detected at the nursery, place of growth, or in the submitted photographs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

B. Fine Grading and Soil Preparation: Verify that fine grading and soil preparation Work is complete.

C. Verification Surface Drainage: Verify positive surface drainage of planted areas.

D. Notification: Before proceeding with Work, notify the Owner's Representative in writing of unsuitable conditions.

3.2 PREPARATION

A. Protection of Existing Conditions:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
3. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
5. Submit written notification of damaged plants and structures to the Owner's Representative immediately.

3.3 SUBSURFACE OBSTRUCTIONS

A. Plant Pit Excavation:

1. If rock, underground utilities, structures, tree roots or other obstructions are encountered in the excavation of plant pits, alternate locations may be accepted by the Landscape Architect.
2. Submit written notification of encountered obstructions to the Landscape Architect immediately.

B. Irrigation Piping: Reroute around the plant root ball.

C. Irrigation Valves: Re install outside of hedge line and/or plant rootball.

3.4 PLANT LAYOUT

A. Trees:

1. Stake location of trees where indicated on Drawings.
2. Scale tree locations where no dimensions are given.
3. Drive a 3-foot long wood lath stake at each tree location and mark each tree type with different color survey tape.
4. Contact the Landscape Architect to review locations in field prior to excavating plant pits and installing irrigation.
5. Do not excavate plant pits or install irrigation until the Landscape Architect has accepted plant locations.

B. Planting Bed Limits for Each Type of Shrub:

1. Spray paint on the ground for the individual shrub mass bed type limits for review of the planting bed line curvature.
2. Scale planting bed limits from planting Drawings where no dimensions are given.
3. Contact Landscape Architect to review bed outlines in field prior to excavating plant pits and installing irrigation.
4. Do not excavate plant pits or install irrigation until the Landscape Architect has accepted plant locations.

3.5 EXCAVATION OF TREE, PALM TREE, AND SHRUB PLANT PITS

A. Equipment:

1. Excavate square pits with a back-hoe or hand digging.
2. Do not use an auger.

B. Dimensions:

1. Where not indicated on the Drawings, excavate plant pits to a depth equal to the root ball height minus the amount needed to allow for settlement and to install the root balls at the specified elevation relative to adjacent finished grade.
2. Install top of plant root balls 1 inch above adjacent finished grade, or higher if required to allow settlement, except where indicated otherwise.
3. Excavate pits to a diameter which is 3 times the root ball diameter, except where indicated otherwise on the Drawings, and except for Palm trees.
4. Center plant pits on plant locations where possible.
5. Where plant pits cannot be excavated to specified dimensions nor centered on plants due to obstructions such as paving, walls, curbs, or other structures excavate pits in directions without obstructions until pit volume equals the specified plant pit volume, except where indicated otherwise.
6. Do not undercut adjacent obstructions unless accepted by the Landscape Architect.
7. Excavate plant pit sides along adjacent elements such as paving, walls, curbs, and other structures at a 45 degree angle sloping away from the bottom surfaces of the adjacent elements, except where indicated otherwise.

3.6 PLANTING AND BACKFILL OPERATIONS FOR TREES, SHRUBS, AND GROUNDCOVERS (NOT PALM TREES)

A. Protection of Plants Prior to Installation:

1. Protect plant root balls from sun or drying winds.
2. Keep root balls of plants that cannot be planted immediately upon delivery in the shade, well-protected and well-watered.

B. Removal of Containers:

1. Remove canned stock carefully after cans have been cut on two sides with accepted cutter.
2. Do not use spade to cut containers.

C. Root Ball Scarification:

1. After removing plant from container, scarify side of root ball to prevent root-bound condition.
2. Loosen root ball soil surface to depth of 1/8-inch to 1/4-inch without damaging roots or breaking root ball.

D. Cutting Circling Roots:

1. If circling roots are encountered at root ball sides, notify the Landscape Architect for field review.
2. Upon the Landscape Architect's acceptance, cut roots on 4 sides of root ball 90 degrees apart at no additional cost to the Owner.
3. Use a 4-inch wide sharp straight blade.
4. Cut roots by pushing spade or knife down sides of root ball 90 degrees to root ball surface and 2 inches into root ball.
5. Keep spade or knife sharp to cut roots cleanly.

E. Plant Placement:

1. Handling plant carefully, set plant root ball on pit bottom centered on accepted horizontal location.
2. Install plant root ball vertically so that top of root ball is 2 inches above adjacent finished grade after settlement except where indicated otherwise.

F. Removal of Root Ball Wrapping Materials: Remove and dispose of burlap, nylon cord, wire baskets, twine and other materials prior to backfilling.

G. Soil Mix Placement:

1. Place mix carefully as not to damage the plant root ball, trunk, branches, or foliage.
2. Fill area or pit until top of backfill mix is even with top of root ball.

H. Fertilizer Application after Soil Mix Placement:

1. Apply Nutri-Sorb at rate of 2.5 pounds per caliper inch of tree on the rootball and into the surface backfill soil. For container plants apply 6 ounces per gallon of size and incorporate into the top of container and backfill.
2. Apply a 1:20 dilution of VermaPlex and drench backfill of rootball with 1 gallon drench per 1 inch caliper of tree. Drench container plants with 0.5 gallons of diluted VermaPlex per gallon size.
3. Sprinkle surface of soil mix with 2 inches of water after application of fertilizers.

I. Backfill and Soil Mix Settlement:

1. After backfill mix has been drenched with fertilizers and has dried for 2 days, settle mix by watering evenly.
2. Fill settled backfill mix areas with additional backfill mix as required to bring it even with top of root ball, drench added backfill mix with water and allow to dry for 2 days.
3. Continue filling settled areas and drenching with soil-conditioner water mix until settlement stops.
4. Do not install backfill mix over conditioned backfill mix without drenching it with soil-conditioner water mix.

J. Settled Plant Adjustment: Raise plant root balls which settle so that top of root balls are at the specified elevation relative to adjacent finished grade.

3.7 PALM TREE PLANTING AND BACKFILL OPERATIONS

A. Protection of Plants Prior to Installation:

1. Protect plant root balls from sun or drying winds.
2. Keep root balls of plants that cannot be planted immediately upon delivery in the shade, well-protected and well-watered.

B. Plant Placement:

1. Handling plant carefully, set plant root ball on pit bottom centered on accepted horizontal location.
2. Install plant root ball vertically so that top of root ball is 2 inches above adjacent finished grade after settlement except where indicated otherwise.

C. Removal of Root Ball Wrapping Materials: Remove and dispose of burlap, nylon cord, wire baskets, twine, boxing material, and other materials prior to backfilling.

D. Backfill Mix Placement:

1. Backfill palm pit with palm tree pit backfill mix.
2. Continuously adjust palm to insure a plumb and rigidly-based trunk.
3. When plant pit has been backfilled approximately 2/3 full, water thoroughly to saturate before installing remainder of backfill.
4. Fill pit until top of backfill mix is 2 inches below the top of root ball.

E. Fertilizer Placement: Apply Palm Perfection at 5 pounds per caliper inch of tree. Place on top of root ball and incorporate into backfill.

F. Backfill Mix Settlement:

1. After backfill mix has been drenched with compost tea and has dried for 2 days, settle mix by watering evenly.
2. Fill settled backfill mix areas with additional backfill mix as required to bring it 2 inches below top of root ball, drench added backfill mix with water and allow to dry for 2 days.

G. Settled Plant Adjustment: Raise plant root balls which settle so that top of root balls are at the specified elevation relative to adjacent finished grade.

3.8 PALM TREE GUYING

A. Guying:

1. Palms shall be able to stand upright and may require guying to counter site wind conditions. All palms shall remain plumb and straight for all given conditions from installation through the Warranty Period.
2. Palm guying, if required, shall be as described below:
   a. Guy palms at point 1/3 of the way down from the bottom of the crown bud to finish grade.
   b. Guying collar shall be either drilled to accept bolt-type guying anchors or with guying anchors welded securely to the collar.
   c. Locate guys in three equidistant locations around the outside of the collar. Provide three guys per palm with a turnbuckle for each guy. Use 2 cable clamps at each cable connection.
   d. Connect cable to deadmen or ground anchor assembly.

3.9 WOOD POLE TREE STAKING SYSTEM

A. Locations, Stake Size, and Stake Quantity: Refer to Schedule at end of this Section.

B. Orientation:

1. Locate stakes in a line with trunk of tree, as close to the main trunk as possible without penetrating root ball.
2. Locate line of stakes and trunk perpendicular to the prevailing wind direction.

C. Stake Depth:

1. Drive 8-foot long stakes into soil to minimum 12 inches below the root-ball bottom.
2. Drive 10-foot long stakes into soil to minimum 12 inches below the root-ball bottom.
3. Pre-drill pilot holes 1/2 diameter of stake if required to drive stakes in hard soil conditions.

D. Tying Trees to Stakes Trees:

1. Refer to detail on Drawings.
2. Tie ends of ties with double-back locking configuration as recommended by the tie manufacturer.

3.10 METAL PIPE TREE STAKING SYSTEM

A. Locations and Stake Size: See Schedule at end of this Section.

B. Orientation: Install stakes on prevailing-wind side of trees.

C. Stake and Tree Tie Installation: Install in accordance with manufacturer's current printed instructions, and the accepted mock-up.

3.11 ROOT BALL ANCHOR SYSTEMS

A. Trees Requiring Root Ball Anchor System Kits: Install root ball anchor systems on the trees, in lieu of tree stake systems.

B. Root Ball Anchor Kit Manufacturer's Requirements: Install in accordance with the manufacturer's current printed installation instructions.

3.12 WOOD CHIP MULCH INSTALLATION

A. Depth:

1. Install a uniform 2-inch depth mulch layer over plant watering basins and shrub areas except where indicated otherwise.
2. Install uniform 2-inch depth mulch layer over ground cover areas, except where indicated otherwise.
3. Install uniform 3-inch depth mulch layer over planting areas where indicated on the Drawings.

B. Surface: Rake mulch surface smooth.

C. Woody Plant Stems: Slope mulch away from woody plant stems so that mulch does not touch stems.

END OF SECTION

SECTION 33 1110 – SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and specialties outside the building for the following:

1. Water services.
2. Fire-service.

1.2 DEFINITIONS

A. Fire-Service: Exterior fire-suppression-water piping branch from service main to backflow preventer and into building fire suppression-water system.

B. Fire-Suppression-Water Piping: Interior fire-suppression-water piping.

C. Water Service: Exterior domestic-water piping branch from service main into building to water distribution piping.

D. The following are industry abbreviations for piping materials:

1. PE: Polyethylene plastic.
2. PVC: Polyvinyl chloride plastic.
3. DI: Ductile iron.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Piping specialties.
2. Valves and accessories.
3. Water meters.
4. Backflow preventers and assemblies.
5. Protective enclosures.
6. Fire hydrants.
7. Fire department connections.
8. Alarm devices.
9. Drinking fountains.

B. Coordination Drawings: For piping and specialties including relation to other services in same area. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

C. Field Quality-Control Test Reports: From Contractor.

D. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Valves.
2. Backflow preventers.
3. Protective enclosures.
4. Fire hydrants.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Regulatory Requirements:

1. Comply with requirements of utility company supplying water, only as applicable to University's requirements. The University's standard details shall be used.
2. Comply with standards of University's Representative (EH&S) for disinfection of potable water service piping.
3. Comply with standards of OCFA and SFM for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in California Electric Code (NFPA 70), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping.

G. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSFpw" on piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

H. Pre-installation conference: Conduct conference at Project site to comply with requirements of Division/Section "Project Management and Coordination`.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dewpoint temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify University’s Representative not less than two weeks in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without University Representative’s written permission. University personnel will conduct all utility system shutdowns and startups.
3. If utility interruption is for more than four hours, provide temporary utility service.

1.7 COORDINATION

A. Coordinate connection to existing water main with University’s Representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
3. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01 Section “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, AWWA C116, epoxy coated in interior and exterior with mechanical-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, AWWA C116, epoxy coated ductile- or gray-iron standard pattern or AWWA C153, AWWA C116, ductile-iron compact pattern.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and stainless steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, AWWA C116, epoxy coated with push-onjoint, bell- and plain-spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, AWWA C116, epoxy coated interior and exterior ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Gaskets: AWWA C111, rubber.

C. Grooved-End, Ductile-Iron Pipe: AWWA C151, epoxy coated with one or both ends with cut rounded grooves according to AWWA C606.

1. Ductile-Iron, Grooved-End Fittings: ASTM A 47, epoxy-coated malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
2. Ductile-Iron-Piping Keyed Couplings: epoxy coated AWWA C606, AWWA C116, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and stainless steel bolts and nuts.

D. Ductile-Iron Flexible Expansion Joints: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, epoxy coated, exterior and interior. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and stainless steel bolts.

E. Ductile-Iron Deflection Fittings: Compound, ductile-iron coupling fitting epoxy coated interior and exterior, with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and stainless steel bolts.

F. Ductile-Iron Expansion Joints: Three-piece, epoxy coated ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and stainless steel bolts.

G. Reducing Couplings: Shall not be used.

2.4 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

1. Copper Fittings: ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings.

B. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.

1. Copper Fittings: ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings.

C. Bronze Flanges: ASME B16.24, Class 150, (DR14) with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.5 PVC PIPE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900, Class 200, (DR14) with bell end with gasket and spigot end.

1. Comply with UL 1285 for fire-service mains.
2. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

    a. Gaskets: AWWA C111, rubber.
    b. Coating: Fusion bonded epoxy coating, both interior and exterior per AWWA C116.

3. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

    a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and stainless steel bolts.
    b. Coating: Fusion bonded epoxy coating, both interior and exterior per AWWA C116.

2.6 JOINING MATERIALS

A. Refer to Division 33 Section "Common Work Results For Utilities" for commonly used joining materials.

B. Transition Couplings:

1. Underground Piping, NPS 1-1/2 and Smaller: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
2. Underground Piping, NPS 2 and Larger: AWWA C219, metal, sleeve-type coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
3. Aboveground Piping: Pipe fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

C. Brazing Filler Metals: AWS A5.8, BCuP3 or BCuP4 Series.

D. Soldering Flux: ASTM B 813, water-flushable type.

E. Solder Filler Metal: ASTM B 32, lead-free type with 0.20 percent maximum lead content.

F. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Flange and gasket type and material recommended by piping system manufacturer. Bolts and nuts shall be stainless steel.

2.7 PIPING SPECIALTIES

A. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with coppertube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

B. Dielectric Fittings: Combination of copper alloy and ferrous; threaded, solder, or plain end types; and matching piping system materials.

1. Dielectric Unions: Not acceptable for use.
2. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure to suit system pressures.
3. Dielectric-Flange Insulation Kits: Field-assembled companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and stainless steel backing washers.

    a. Provide separate companion flanges and stainless steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.

4. Dielectric Couplings: Galvanized-steel couplings with inert and non-corrosive thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F.
5. Dielectric Nipples: Electroplated steel nipples with inert and non-corrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig minimum working pressure at 225 deg F.
6. Six inch red brass nipple and union.

2.8 CORROSION-PROTECTION ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, 8mil. Minimum thickness, PE film in tube or sheet.

B. Nuts, bolts, clamps and accessories below grade shall be stainless steel. Bolt threads shall be sealed with silicon only (no grease or bitumastic). Stainless steel bolts and nuts shall be Teflon coated to prevent galling of the material during assembly.

2.9 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers:

    a. American Cast Iron Pipe Co.; American Flow Control Div.
    b. American AVK.
    c. Grinnell Corporation; Mueller Co.; Water Products Div.
    d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).

e. McWane, Inc.; Kennedy Valve Div.
f. McWane, Inc.; M&H Valve Company Division
g. United States Pipe and Foundry Company.
h. Or equal.

2. Non-rising-Stem, Resilient-Wedge Gate Valves: AWWA C509, ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut. Valves shall be full wall thickness whether using cast iron or ductile iron. The wall thickness reductions allowed by AWWA C515 shall not be used on University Projects.

a. Rated Operating Pressure: 250 psig.
b. Test Pressure : 500psig
c. End Connections: Mechanical joint or flanged.
d. Interior and exterior coating: Comply with ANS/AWWA C550, standard for Protective Interior Coating of hydrants and valves.
e. Body to Bonnet bolts: Stainless steel 18-8
f. Stem shall have an integral thrust collar. Two-piece assemblies shall not be provided.
g. Grate shall be fully encapsulated in EPDM or SBR. Gate shall have Delrin or other anti-friction insert (s) to reduce operating torque.
h. Valves in buried service shall have a 2 inch square operating nut.

3. OS&Y, Rising-Stem, Resilient-Seated Gate Valves: AWWA C509, UL 262, FM-approved cast-iron or ductile-iron body and bonnet, outside screw and yoke; with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem. Valves shall be full wall thickness whether using cast iron or ductile iron. The wall thickness reductions allowed by AWWA C515 shall not be used on University Projects.
a. Minimum Working Pressure: 200 psig.
b. End Connections: Flanged.
c. Interior and Exterior Coating: Complying with AWWA C550, epoxy.

2.10 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies: Comply with MSS SP-60. Include sleeve and valve compatible with drilling machine. Where line-stopping or other activity that is similar to tapping occurs, the same requirements for tapping sleeves shall be followed.

1. Manufacturers:

a. Mueller Co.; Water Products Div.
b. JCM Industries.

2. Tapping Sleeve: Cast- or ductile-iron or stainless steel, mechanical joint tapping sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve. The tapping sleeve

shall provide a mechanical joint fitting at each end so that a failure of the pipe being tapped will not cause a leak. Unless it has positively been determined that the pipe to be tapped is not ACP, the sleeve shall be compatible for use with ACP.

a. JCM Industries No. 414 mechanical joint tapping sleeve with fusion-bonded epoxy coating interior and exterior.
b. Mueller Co.; H-615 or H-619 mechanical joint tapping sleeve with fusion- bonded epoxy coating interior and exterior.

3. Valve: AWWA, C509 cast-iron, fusion-bonded, epoxy coated. Non-rising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Include triangular top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve. The triangular top section is deliberately different from the Standards of the Irvine Ranch Water District for potable water.

1. Provide precast concrete valve box by Christy or equal with one-piece 8” SDR 35 or SCH 40 PVC extension to valve per standard detail 33 W-7a or
2. Provide cast-iron valve box complying with AWWA M44 with approximately 5-inch diameter barrel per standard detail 33 W-7a.
3. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.11 CHECK VALVES

A. AWWA Check Valves:

1. Manufacturers:

a. American Cast Iron Pipe Co.; American Flow Control Div.
b. American AVK.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Grinnell Corporation; Mueller Co.; Water Products Div.
f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
g. McWane, Inc.; Kennedy Valve Div.
h. McWane, Inc.; M & H Valve Company Div.
i. NIBCO INC.
j. Valve and Primer Corp.
k. Watts Industries, Inc.; Water Products Div.
l. Or equal.

2. Check Valves: AWWA C508, swing-check type with 175-psig working-pressure rating and resilient seat. Include interior and exterior epoxy coating according to AWWA C550 and ends to match piping.

B. UL-Labeled Check Valves:

1. Manufacturers:

a. American AVK.
b. Central Sprinkler Company.
c. Crane Co.; Crane Valve Group; Stockham Div.
d. Firematic Sprinkler Devices, Inc.
e. Globe Fire Sprinkler Corporation.
f. Grinnell Corporation.
g. Grinnell Corporation; Mueller Co.; Water Products Div.
h. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
i. McWane, Inc.; Kennedy Valve Div.
j. NIBCO INC.
k. Reliable Automatic Sprinkler Co., Inc.
l. Star Sprinkler, Inc.
m. United Brass Works, Inc.
n. Victaulic Co. of America.
o. Viking Corporation.
p. Watts Industries, Inc.; Water Products Div.
q. Or equal.

2. Check Valves: UL 312, swing-check type with 175-psig working-pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
3. Check Valves: UL 312, swing-check type with 250-psig working-pressure rating, rubber-faced checks unless otherwise indicated, and ends matching piping.

2.12 WATER-REGULATING VALVES

A. Manufacturers:

1. Cla-Val Co.
2. Or equal.

B. Pressure-Regulating Valves: Automatic, pilot-operated, cast-iron body with interior and exterior epoxy coating according to AWWA C550. Include 250-psig working-pressure design, bronze pressure-reducing pilot valve and tubing, and means for discharge pressure adjustment.

C. Flow-Regulating Valves: Automatic, pilot-operated, cast-iron body with interior and exterior epoxy coating according to AWWA C550. Include 250-psig working-pressure design, bronze pressure-reducing pilot valve and tubing, and means for flow adjustment.

2.13 RELIEF VALVES

A. Manufacturers:

1. BERMAD.
2. GA Industries, Inc.
3. MULTIPLEX Manufacturing Co.
4. OCECO, Inc.
5. Val-Matic Valve & Mfg. Corp.
6. Cla-Val Co.
7. Or equal.

B. Combination Air Valves: AWWA C512, float-operated, hydromechanical device to automatically release accumulated air or to admit air. Include 300-psig working-pressure design.

C. Pressure Thermal Expansion relief Valves: Valves shall comply with UL 1478A with Factory Mutual approved. Valves shall be a minimum of ½" and a maximum of 1" as manufactured by

1. Tyco Corp. Kunkle Div: Model 912
2. AGF MFG. Inc. Model No. 7000
3. Or equal

D. All Valves shall be epoxy coated, both interior and exterior according to AWWA C550.

2.14 DETECTOR-TYPE WATER METERS

A. The detector water meter shall be provided by the manufacturer of the double detector check assembly and shall be installed as part of the double detector check assembly of the type and manufacturer as specified below.

2.15 BACKFLOW PREVENTERS

A. Manufacturers and products:

1. Reduced Pressure Detector type. See Division 22 Section "Domestic Water Piping Specialties".

2. Double Check Detector Assembly

a. CMB Industries, Inc.; Febco Div. Model 806YD DCDA.
b. Watts Industries, Inc.; Water Products Div. Model 709 DCDA-OSY-CFM.
c. Wilkens Water Control Products, Zurn Plumbing Products Group. Model 950DAOSY-CFM or 450DA-OSY-CFM.
d. Or equal.

B. General: ASSE standard, backflow preventers.

1. Working Pressure: 150 psig minimum.
2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.

    a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.

3. NPS 2 and smaller: Bronze body with flanged or threaded ends. Provide isolation valves and unions to allow removal of the device without cutting the pipe.
4. Interior Components: Corrosion-resistant materials.
5. Exterior Finish: Fusion bonded epoxy coating.
6. Strainer: Do not furnish strainer on backflow assembly.

C. Reduced-Pressure-Detector Assembly Backflow Preventers: ASSE 1047, FM approved or UL listed, and suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; pressure-differential relief valve with ASME A112.1.2, air-gap fitting located between two positive-seating check valves; and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer.

1. Maximum Pressure Loss: 12 psig through middle 1/3 of flow range.

2.16 FREE STANDING FIRE HYDRANTS

A. Wet-Barrel Fire Hydrants: AWWA C503, two NPS 4 and one NPS 2-1/2 outlets, NPS 6 threaded or flanged inlet with 6 bolts, and base section with NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have 150-psig minimum working-pressure design.

1. Manufacturers and Product:

    a. Jones, James Company, Model No. J-3775.
    b. Clow Model No. 2065.
    c. Or equal (no known equal).

2. Materials of construction: Hydrant top section shall be bronze conforming to ASTM B62. Interior working part, including stems, shall be of bronze containing no more than 7 percent zinc or 2 percent aluminum.
3. Outlet Threads: NFPA 1963, with external hose thread used by OCFA. Include bronze caps with steel chains.
4. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.

5. Direction of Opening: Open hydrant valves by turning operating nut to left or counter clockwise.
6. Exterior Finish: Yellow alkyd-gloss enamel paint.

2.17 FIRE HYDRANT BREAK-OFF CHECK VALVE

A. Provide break-off check valve for immediately stopping the flow of water when a hydrant has been knocked off its mounting. Provide double-grooved break-off riser, enclosed with a concrete collar and properly installed between the check valve and hydrant base.

B. Check valve shall be cast iron with epoxy lining and include bronze check valve flapper, stainless steel spring, stainless steel break-off rod, stainless steel flapper pin and flapper pin plugs.

1. Manufacturers:

a. Long Beach Iron Works (Clow) Model LB400.
b. Or equal.

2.18 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:

1. AFAC, Inc.; Badger Fire Protection.
2. Elkhart Brass Mfg. Co., Inc.
3. Fire End & Croker Corporation.
4. Firematic Sprinkler Devices, Inc.
5. Grinnell Corporation.
6. Guardian Fire Equipment, Inc.
7. Reliable Automatic Sprinkler Co., Inc.
8. Smith Industries, Inc.; Potter-Roemer Div.
9. Or equal.

B. Exposed, Freestanding, Fire Department Connections: UL 405, cast-bronze body, with thread inlets according to NFPA 1963 and matching OCFA hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high brass sleeve; and round escutcheon plate.

1. Connections: Six NPS 2-1/2 inlets and one **NPS 6** outlet.
2. Inlet Alignment: Horizontal.
3. Finish Including Sleeve: Per architecture plans.
4. Escutcheon Plate Marking: "AUTO SPRINKLER"

2.19 ALARM DEVICES

A. Description: UL 753, FM approved, of types and sizes to mate and match piping and equipment.

2.20 MISCELLANEOUS MATERIALS

A. Warning Tape; See Division 31 Section “Earth Moving.” Tape shall state “Caution Potable Water Line Buried Below.”

B. Tracer Wire; See Division 31 Section “Earth Moving.”

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section “Earth Moving” for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

C. Do not use flanges, unions, or keyed couplings for underground piping.

D. Flanges, unions, keyed couplings, and special fittings may be used, instead of joints indicated, on aboveground piping.

E. Underground Water-Service Piping: Use the following piping materials for each size range:

1. NPS 3/4 to NPS 4: Soft copper tube, Type K; wrought-copper fittings; and brazed joints.
2. Option for NPS 2 ½ to NPS 3 1/2; Use NPS3 and NPS4, ductile-iron pipe with the grooved ends; ductile iron grooved end fitting: ductile-iron keyed couplings; and grooved joints.
3. NPS 4 to NPS12; Ductile-iron with grooved ends; ductile-iron grooved end fitting; epoxy coated on interior and exterior, ductile-iron keyed coupling; and grooved joints
4. NPS 4 to NPS 12; PVC, AWWA C900 Class 200 pipe; PVC fabricated or molded fittings of same class as pipe; and gasketed joints. Use ASTM, F 477 elastomeric seals.

F. Aboveground Water-Service Piping: Use any of the following piping materials for each size range:

1. NPS 3/4 to NPS 4: Hard copper tube, Type K; wrought-copper fittings; and brazed joints.
2. Option for NPS 2-1/2 to NPS 3-1/2: Use NPS 3 and NPS 4; ductile-iron pipe with grooved ends; ductile-iron, grooved-end fittings; ductile-iron keyed couplings; and grooved joints epoxy coated on interior and exterior.

3. NPS 4: Ductile-iron pipe with grooved ends; ductile-iron, grooved-end fittings; ductileiron keyed couplings; and grooved joints, epoxy coated on interior and exterior.
4. NPS 6 and NPS 8: Ductile-iron pipe with grooved ends; ductile-iron, grooved-end fittings; ductile-iron keyed couplings; and grooved joints, epoxy coated on interior and exterior.

G. Underground Fire-Service-Main Piping: Use the following:

1. NPS 4 to NPS 12: Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

2. NPS 4 to NPS 12: PVC, AWWA Class 200 pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.

H. Aboveground Fire-Service-Main Piping: Ductile-iron pipe with flanged or grooved ends; ductile-iron, grooved-end or flanged fittings; ductile-iron keyed couplings; and grooved joints epoxy coated on interior and exterior.

I. Underground Combined Water-Service and Fire-Service-Main Piping: Use the following:

1. NPS 6 to NPS 12: Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints epoxy coated on interior and exterior.
2. NPS 6 to NPS 12: PVC, AWWA C900 Class 200 pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-or flanged-end valves for NPS 3 and larger underground installation. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation. All Valves shall be epoxy coated.

B. Valve types to be used:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, non-rising-stem, resilient seated, epoxy coated gate valves with valve box.
2. Use the following for valves above ground:

a. Ball Valves, NPS 2 and Smaller: Bronze, full port stainless steel ball.
b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising or non-rising stem, resilient Wedge seated. Use rising stem valves in fire service and non-rising stems in potable water and regulating stations.
c. Check Valves: AWWA C508, swing-check valves.

3. Water-Regulating Valves: Use for water-service piping aboveground.

a. Pressure-Regulating Valves: To control water pressure.
b. Flow-Regulating Valves: To control water flow.

4. Relief Valves: Use for water-service piping aboveground.

a. Combination Air Valves: To release or admit air.
b. Pressure relief valves; To release pressure build-up per code.

5. Detector Check Valves: Use for fire water-service piping aboveground to detect unauthorized use of water.

3.4 JOINT CONSTRUCTION

A. See Division 33 Section "Common Work Results For Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with keyed couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
4. Copper Tubing Soldered Joints: ASTM B 828. Use flushable flux and lead-free solder.
5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 33 Section "Common Work Results For Utilities" for joining piping of dissimilar metals.

C. Provide stainless steel bolts, nuts and washers both above ground and below ground.

3.5 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Division 33 Section "Common Work Results For Utilities" for piping-system common requirements.

3.6 PIPING INSTALLATION

A. Water-Main Connection:

1. Make connection using a tee fitting or tapping sleeve.

2. No taps or other connections shall be made to existing water mains prior to conducting an approved pressure test on the new water distribution system down stream from the tapping valve. Tapping sleeves shall be pressure tested in an approved manner in the field, in the presence of the inspector, prior to tapping the main line. Tapping of the main line shall not proceed unless the inspector is present.
3. Expose connection point to the existing domestic water system for verification of horizontal and vertical location before starting new connection and piping.

B. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by University standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

D. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105. Encasement shall be complete the entire length and run through wall or floor and be left exposed for visual inspection. Seal end of encasement to pipe in a visual area.

E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105. Encasement shall be complete the entire length and run through wall or floor and be left exposed for visual inspection. Seal end of encasement to pipe in a visual area.

F. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

G. Install PVC, AWWA pipe according to AWWA M23 and ASTM F 645.

H. Bury piping with depth of cover over top of pipe as shown on the drawing profiles according to the following:

1. Mains in paved areas: With at least 42 inches cover over top.
2. Mains in unpaved areas: With at least 48 inches cover over top.
3. Laterals to fire hydrants: With at least 48 inches cover over top.
4. Laterals 4 inches and smaller to buildings: With at least 30 inches cover over top.
5. Laterals 6 inches and larger to buildings: With at least 36 inches cover over top.
6. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.

I. Install piping by tunneling, jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

J. Extend water-service piping and connect to water-supply source and building water piping systems at outside face of building wall.

1. Terminate water-service piping at building wall until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water piping systems when those systems are installed.

K. Sleeves are specified in Division 33 Section "Common Work Results For Utilities."

L. Mechanical sleeve seals are specified in Division 22 Section "Common Work Results For Plumbing."

M. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

1. Thrust blocks shall be installed at all changes in direction, changes in size, valves and terminal ends, such as plugs, caps and tees.
2. Thrust blocks shall be concrete having a compressive strength of not less than 2000 psi after 28 days and shall be in accordance with Division 03, Section “Cast-In-Place Concrete.”
3. Thrust blocks shall be placed between solid ground and the fitting to be anchored. The base and the thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth.
4. The sides of the thrust blocks not subject to thrust may be poured against forms.
5. Thrust blocks shall be placed so that the joints for all fittings will be accessible for repair in the future. No pipe joint shall be embedded in concrete.
6. The thrust blocks shall provide for transfer of thrusts and reactions without exceeding the allowable stress of the concrete and shall be installed in accordance with pipe manufacturer's instructions.

N. See Division 22 Section "Domestic Water Piping and Valves" for potable-water piping inside the building.

O. See Division 21 Sections for Water-Base Fire-Suppression System inside the building.

P. Install water-supply piping with shutoff valve in water supply to each drinking fountain. Use curb valve and service box.

Q. Provide expansion joint when fire service enters the building through basement wall.

R. Buried metallic fittings shall be wrapped with double wrap of PE film before backfill. In addition, buried metallic fittings and appurtenances in PVC pipe installation shall be "bagged" or wrapped with polyethylene before concrete thrust blocks are poured. AWWA C105 applies.

S. Curbs in streets, drives or ring mall shall be inscribed with a "W" indicating location of domestic water service crossing curb.

T. Lay piping on a bed of sand, at least 6 inches thick, on firm undisturbed earth. Remove loose rock, clods, and debris from the trench before placing bedding sand and before laying any pipe.

3.7 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Fire-Service-Main Piping: According to NFPA 24.

B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box. Main line valves shall be accessible at all times during construction. Valves with over 48-inches of cover shall be provided with extension stem as per Campus Standard Detail drawing 33-W-8.

B. Water-Regulating Valves: Install above ground between shutoff valves.

C. Relief Valves: Install above ground with shutoff valve on inlet.

D. Detector Check Valves: Install above ground.

E. Fire Service check valves; Install above ground

F. Main line valves shall be accessible during construction, and valve stem tops having over 48inches of cover shall be provided with extension as per Campus Standard Detail drawing 33-W8.

3.9 DETECTOR CHECK VALVE INSTALLATION

A. Install detector check valves for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.

B. Support detector check valves, meters, shutoff valves, and piping on pipe stand and concrete pad.

3.10 WATER-METER INSTALLATION

A. Water Meters: Install water meters, above ground with shutoff valve and strainer on watermeter inlets. Include shutoff valves on water-meter inlets. Support meters, valves and piping on pipe stands.

3.11 BACKFLOW-PREVENTER AND DETECTOR CHECK INSTALLATION

A. Install backflow preventers detector check assemblies of type, size, and capacity indicated above ground. Include valves and test cocks. Install according to requirements of California Plumbing Code and Orange County Health Department and University's Representative.

B. Do not install backflow preventers with relief drain in vault or other space subject to flooding.

C. Do not install bypass piping around backflow assemblies

D. Install NPS2 and swollen backflow assemblies in such a way that the assembly can be removed from the piping without cutting or unsoldering piping. Provide additional valves, flanges or unions as necessary. NPS 21/2 and larger backflow assemblies shall be flanged. Ensure assemblies are installed such that they can be removed without springing the pipe.

E. Support NPS 2-1/2 and larger backflow preventers, valves, and piping above grade at low elevation and on pipe stands and concrete pad. Backflow shall be low while still allowing maintenance and not overly high to avoid an unsightly visual appearance. Coordinate to provide visual barriers such as retaining walls and/or bushes to conceal backflow. Assemblies shall be installed such that its lowest point is a minimum of 12 inches above the finished surface with a preferred minimum of 24 inches.

F. Install pressure relief valve, immediately downstream of Backflow assembly on the service and discharge drain in non-obstructive way. Relief valve shall be set at not more than 175 psig. G. Provide 5-foot clearance on each side around backflow cross connection devices.

3.12 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position. If hydrant is more than 10 feet from the main line install a second valve near the main line with a second valve near the hydrant as required by the University's standard detail.

B. Installation shall be in accordance with the University's Standard details.

C. AWWA-Type Fire Hydrants: Comply with AWWA M17.

D. Provide break-off check valve. With installation of break-off check valve, no break-away bolts shall be installed.

E. Fire hydrants shall be set with the bottom flange of breakaway spool 6-inches above the concrete pad or sidewalk and shall be located a minimum of 2.5 feet and maximum of 3.0 feet from curb.

F. When used, breakaway bolts in base of hydrant shall be installed with the threads up and the hollows shall be filled and sealed with silicon. The hydrant shall be installed at such a height that the bolts can be removed without interference from the surface below the hydrant flange.

G. Both of the fire hydrants 4 inch port outlets shall face the emergency access roadway at 45 degrees to the road.

3.13 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install fire department connections.

B. Install ball drip valves at each check valve for fire department connection.

C. Install protective pipe bollards to protect from accidental damage from vehicles on sides of each freestanding fire department connection. Refer to Division 05 Section "Metal Fabrications" for pipe bollards.

3.14 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.

B. Locking and Sealing: Secure unsupervised valves as follows:

1. Valves: Install chain and padlock on open OS&Y gate valve.

C. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch into the threaded hole.

D. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.

E. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Division 28 Section "Digital Addressable Fire Alarm System."

3.15 DRINKING FOUNTAIN INSTALLATION

A. Install drinking fountains anchored to concrete pavement or to concrete block. Install per manufacturer's recommendations.

3.16 CONNECTIONS

A. Connect water-distribution piping to University's existing water main. Use tapping sleeve and tapping valve or flanged tee.

B. Connect water-distribution piping to hydrants .

C. Connect water-distribution piping to interior domestic-water and fire-suppression piping as required for the project.

D. Connect waste piping from drinking fountains to sanitary sewerage system. See Division 33 Section "Facility Sanitary Sewer" for connection to sanitary-sewer] piping.

E. Ground equipment according to Division 26 Section "Grounding and Bonding For Electrical Systems."

F. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.17 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at 150 psig or 1-1/2 times working pressure, whichever is greater, for 4 hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 2 hours; decrease to 0 psig. Slowly increase again to test pressure and hold for 2 more hours. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

D. Backflow Assemblies: Backflow assemblies shall be tested by a certified tester.

E. Fire main and water mains serving fire suppression risers and fire hydrant piping shall be pressure tested and flushed before backfilling according to the procedures set forth in NFPA 24. The DCFM shall witness an inspection of underground installation, back flush, and hydrostatic test. Hydrostatic testing shall be made with before joints are covered. Backfill between joints before testing to prevent movement of piping.

3.18 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-service piping. See Division 31 Section "Earth Moving" for underground warning tapes.

B. Install tracer wire on top of and attached to pipe for all non-ferrous piping. See Division 31 Section "Earth Moving" for tracer wirer.

C. Show termination points for tracer wire on record drawings.

3.19 ADJUSTING

A. Adjust drinking fountain flow regulators for proper flow and stream height.

3.20 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Use purging and disinfecting procedure prescribed, use procedure described in AWWA C651 or as described below:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
b. An optional disinfecting procedure that can be used in lieu of paragraph above is to drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.

c. Submit water samples in sterile bottles to the University’s Representative for review and acceptance by the University’s Environmental Health and Safety Representatives. Repeat procedure if biological examination shows evidence of contamination.
d. Underground mains shall be flushed at maximum flow during non-peak campus usage time

B. Prepare reports of purging and disinfecting activities.

C. After completing drinking fountain installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

D. Clean drinking fountains, on completion of installation, according to manufacturer's written instructions.

3.21 EMERGENCY CONTACT

A. The existing water, sewer, storm drain, electrical, gas, high temperature water, compressed air, chilled water, underground utilities on campus, with the exception of some private Utility company lines, are under the care custody and control of the University's Facilities Management Department. Only under extreme emergency circumstances shall a contractor shutdown or interrupt existing lines or utilities.

B. In the event of an emergency, UCR Facilities Management is to be notified immediately. Contact the Facilities Management Service Desk at (951) 827-4214. Since it is impossible for a contractor to have an understanding of the entirety of the impacts that such a shut down on campus may have, the immediate and sustained involvement of Facilities Management personnel is essential. For example, it is possible that a decision will be made to allow water to run for some time rather than shut down the campus. Like calling 911 for other emergencies, it is not necessary or appropriate to wait for approval from the project manager to call Facilities Management in these cases. UCI Facilities Management personnel will perform shutdowns and close the appropriate valves to isolate the area of work.

C. Schedule outages for utility tie-in work in advance and state the maximum duration of shutdown. Operation of the central plant governs. The construction schedule may have to be adjusted to perform work during off-hours.

END OF SECTION 33 1110

SECTION 33 16 00 - STORAGE TANKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underground Water Tanks:
   1. Tank installations in the following locations:
      a. United States.
   2. For the following applications:
      a. Rainwater Harvesting / Stormwater Detention.

1.2 RELATED SECTIONS

A. Section 31 2000 – Earth Moving

B. Section 31 5000 – Excavation Support and Protection.

C. Section 32 1313 – Concrete Paving.

1.3 REFERENCES

A. Underground Water Tanks in the United States:
   1. American Concrete Institute (ACI) standard ACI 318, Building Code Requirements for Structural Concrete.
   2. ANSI/AWWA D120 - Thermosetting Fiberglass-Reinforced Plastic Tanks.
   3. Tank manufacturer shall be recognized by Underwriters Laboratories as a manufacturer of tanks listed to the UL-1316 standard.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data sheets on each product to be used, including, but not limited to, the following:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation manual and operating guidelines.

B. Shop Drawings: Tank manufacturer shall submit the following for review and approval prior to fabrication of the tanks:
   1. Detailed shop drawings of each tank complete with all accessories supplied by the manufacturer.
   2. Detailed shipping, handling and installation instructions.

1.5 QUALITY ASSURANCE

A. Tank installations in the United States:
   1. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with tank manufacturer's Installation and Operating Guidelines recommendations for delivery, storage, and tank handling.

1.7 WARRANTY

A. Warranty: Provide manufacturer's standard limited warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Tank installations in the United States:
   1. Acceptable Manufacturer: Xerxes Corporation, which is located at: 7901 Xerxes Ave. S.; Minneapolis, MN 55431; Tel: 952-887-1890; Fax: 952-887-1882; Email:info@xerxes.com; Web:www.xerxes.com

B. Substitutions: Not permitted without prior approval from University.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600 - Product Requirements.

2.2 UNDERGROUND WATER TANKS

A. Tank Design - Fiberglass reinforced plastic (FRP) tanks:
   1. The tank size, fittings and accessories shall be as shown on the drawings.
   2. Tank shall be manufactured with structural ribs which are fabricated as in integral part of the tank wall.
   3. Tank shall be manufactured with a laminate consisting of resin and glass fiber reinforcement only. No sand/silica fillers or resin extenders shall be used.
   4. Tank shall be vented to atmospheric pressure.
   5. Tank shall be capable of handling liquids with specific gravity up to 1.1
   6. Tank shall be compatible with liquids identified in the manufacturer's standard limited warranty.

B. Loading Conditions - Tank shall meet the following design criteria:
   1. Internal Load - Tank shall be designed to withstand a 5-psig (35 kPa) air-pressure test with a 5:1 safety factor.
   2. Surface Loads - Tank shall be designed to withstand surface H-20 and HS-20 axle loads when properly installed according to manufacturer's current Installation Manual and Operating Guidelines.
   3. External Hydrostatic Pressure - Tank shall be designed for 7 feet (2.1 m) of overburden over the top of the tank, the hole fully flooded, and a safety factor of 5:1 against general buckling.

C. Rainwater Harvesting / Stormwater Detention Applications:
   1. Governing Standards, as applicable:
      a. ANSI/AWWA D120 - Thermosetting Fiberglass-Reinforced Plastic Tanks.
      b. American Concrete Institute (ACI) standard ACI 318, Building Code Requirements for Structural Concrete.

c. Tank manufacturer shall be recognized by Underwriters Laboratories (UL) as a manufacturer of tanks listed to the UL-1316 standard.

2. Tank Design: Single-Wall or vessel as specified and shown on the Drawings.

3. Tank Accessories - Rainwater Harvesting / Stormwater Detention Applications:
   a. Tank Anchoring:
      1) Anchor straps shall be as supplied by tank manufacturer and designed for a maximum load of 25,000 lbs (11340 kg).
      2) Galvanized turnbuckles shall be supplied by the tank manufacturer.
      3) Prefabricated concrete anchors shall be supplied by the tank manufacturer, designed to the ACI 318 standard, manufactured with 4,000 psi concrete and shall have adjustable anchor points.
   b. Access Openings:
      1) All access openings shall have a diameter of 24 inches or 30 inches (610 mm or 762 mm), complete with riser, lid and necessary hardware.
   c. Attached Access Risers:
      1) Attached access risers shall be PVC or FRP as supplied by tank manufacturer.
      2) Attached access risers shall be 24 inches or 30 inches (610 mm or 762 mm) diameter
      3) Access risers shall be attached to access openings during installation utilizing adhesive or FRP bonding kits as supplied by the tank manufacturer.
   d. Piping and Fittings:
      1) Tank shall be equipped with factory-installed threaded fittings, or pipe stubs.
      2) PVC piping shall at a minimum meet the requirements of ANSI Schedule 40.
      3) All flanged nozzles shall be flanged and flat-faced, and conform to Class 150 bolting patterns as specified in ANSI/ASME/ B16.5.
      4) Carbon steel and stainless steel NPT fittings shall withstand a minimum of 150 foot-pounds (203 NM) of torque and 1,000 foot-pounds (1356 NM) of bending, both with a 2:1 safety factor.
   e. Manway Openings:
      1) The standard manway shall be flanged, 22 inches (559 mm) I.D. and complete with gaskets, bolts and cover.
      2) Manway openings shall be designed to withstand 5-psig (35 kPa) test pressure with a 5:1 safety factor.
   f. Ladders: Ladders shall be the standard FRP ladder as supplied by tank manufacturer.

PART 3 EXECUTION

3.1 TESTING

A. Tank shall be tested according to the tank manufacturer's Installation Manual and Operating Guidelines in effect at time of installation.

3.2 INSTALLATION

A. Tank shall be installed according to the tank manufacturer's Installation Manual and Operating Guidelines in effect at time of installation.

END OF SECTION

SECTION 33 3100 – FACILITY SANITARY SEWER

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:

1. Backwater valves.
2. Cleanouts.
3. Precast concrete manholes.

1.2 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.
2. Backwater valves.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include concrete design-mix report for cast-in-place concrete.

C. Field quality-control test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic materials, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify University's Representative no fewer than 14 days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without University Representative's written permission.

1.7 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project Sit to comply with requirements in Division 01 Section "Project Management and Coordination".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01, Section 01 6000, "Product Requirements", Part 2 "Product Substitutions" Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.8 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-andspigot ends for gasketed joints with ASTM F 477, elastomeric seals.

B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T- 2 wall thickness, with belland-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

C. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

D. PVC Force Main Sewer Pipe and Fittings: AWWA C-900, class 150 pipe standard ends and ASTM F477 class to metric seals.

2.9 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS Inc.
f. Plastic Oddities, Inc.
g. Or equal

D. Shielded, Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.
d. Or equal.

E. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1. Manufacturers:

a. Fernco Inc.
b. Logan Clay Products Company (The).
c. Mission Rubber Company; a division of MCP Industries, Inc.
d. Or equal.

F. Nonpressure-Type, Rigid Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. ANACO.
b. Or equal.

2.10 BACKWATER VALVES

A. Gray-Iron Backwater Valves: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.

1. Manufacturers:

a. Josam Company.
b. Smith, Jay R. Mfg. Co.
c. Wade Div.; Tyler Pipe.
d. Watts Industries, Inc.
e. Watts Industries, Inc.; Enpoco, Inc. Div.
f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
g. Or equal.

2. Horizontal Type: With swing check valve and hub-and-spigot ends.
3. Combination Horizontal and Manual Gate-Valve Type: With swing check valve, integral gate valve, and hub-and-spigot ends.
4. Terminal Type: With bronze seat, swing check valve, and hub inlet.

B. PVC Backwater Valves: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

1. Manufacturers:

a. Canplas Inc.
b. IPS Corporation.
c. NDS Inc.
d. Plastic Oddities, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.
g. Or equal.

2.11 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:

a. Josam Company.
b. MIFAB Manufacturing Inc.
c. Smith, Jay R. Mfg. Co.
d. Wade Div.; Tyler Pipe.
e. Watts Industries, Inc.
f. Watts Industries, Inc.; Enpoco, Inc. Div.
g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
h. Or equal.

2. Top-Loading Classification: Heavy duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

1. Manufacturers:

a. Canplas Inc.
b. IPS Corporation.
c. NDS Inc.
d. Plastic Oddities, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.
g. Or equal.

2.12 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping or Fittings: ASTM A 674 or AWWA C105.

1. Form: Sheet or tube.
2. Material: high-density, crosslaminated PE film of 8 mil. Minimum thickness, Tube or sheet.
3. Color: Black or Natural.

2.13 MANHOLES

A. Designed Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.

1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
2. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

3. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches.

4. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
5. Manhole Frames and Covers: Ferrous frame; 30 or 36-inch, ID by 6-inch minimum riser with 4-inch-minimum width flange and 32 or 38-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "UCI SEWER."

   a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
   b. Protective Coating: Foundry-applied, coal-tar, epoxy-polyamide paint; 10-mil minimum thickness applied to all surfaces, unless otherwise indicated.

B. Manhole Cover Inserts: Manufactured, form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.

1. Manufacturers:

   a. FRW Industries; a Syneco Systems, Inc. Company.
   b. L.F. Manufacturing, Inc.
   c. Parson Environmental Products, Inc.
   d. Or equal.

2. Type: With valve.

2.14 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

2.15 MISCELLANEOUS MATERIALS

A. Paint: SSPC-Paint 16.

B. PE Sheeting: ASTM D A674, with at least 8-mil thickness.

C. Warning Tape: See Division 31 Section “Earth Moving”. Tape shall state “Caution Sanitary Sewer Buried Below”.

D. Tracer Wire: See Division 31 Section “Earth Moving”.

E. Laboratory Waste Piping: See Division 22 Section “Chemical Waste Systems for Lab and Healthcare.”

PART 3 – EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section “Earth Moving”.

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

a. Shielded flexible or rigid couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:

1. NPS 3: Hub-and-spigot, Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. NPS 3: Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and coupled joints.
3. NPS 4: Hub-and-spigot, Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
4. NPS 4: Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and coupled joints.
5. NPS 4: ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
6. NPS 5 and NPS 6: Hub-and-spigot, Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
7. NPS 5 and NPS 6: Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and coupled joints.
8. NPS 5 and NPS 6 : NPS 6 ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
9. NPS 5 and NPS 6: NPS 6 PVC sewer pipe and fittings, gaskets, and gasketed joints.
10. NPS 8 and NPS 10: ABS, SDR 42, sewer pipe and fittings; gaskets; and gasketed joints.
11. NPS 8 and NPS 10: PVC sewer pipe and fittings, gaskets, and gasketed joints.
12. NPS 12: ABS, SDR 42, sewer pipe and fittings; gaskets; and gasketed joints.
13. NPS 12 and NPS 15: PVC sewer pipe and fittings, gaskets, and gasketed joints.
14. NPS 18 to NPS 24: PVC sewer pipe and fittings, gaskets, and gasketed joints.

D. Force-Main, Pressure Piping: Use the following pipe materials for each size range:

1. NPS 2: PVC Schedule **80**, water-service pipe; PVC Schedule **80**, waterservice-pipe fittings; and solvent-cemented joints.

2. NPS 3: PVC Schedule **80**, water-service pipe; PVC Schedule **80**, waterservice-pipe fittings; and solvent-cemented joints.

3. NPS 6 to NPS 8: PVC pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.

4. NPS 10 and NPS 12: PVC pressure pipe; compact-pattern, ductile-iron fittings; gaskets; and gasketed joints.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for the end of line with future connections, change in grade or size, change in alignment or intersection of two or more mains. Use fittings for branch connections. Direct tap into existing sewer is Only allowed when branch is two pipe sizes smaller than existing sewer main.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.

F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent for branches to buildings.
2. Install sewer mains piping with 48-inch minimum cover.
3. Sewer mains minimum slope shall be per following table:

SEWER SIZE	SLOPE AT:
6	0.0100
8	0.0080
10	0.0055
12	0.0040
15	0.0030
18	0.0020
21	0.0015

4. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

5. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.4 PIPE JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 33 Section "Common Work Results For Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomericseal joints or ASTM D 3034 for elastomeric-gasket joints.
2. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

3.5 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

E. E. Install manhole cover inserts in frame and immediately below cover.

F. Temporary covers may be necessary in new streets. In these cases, the manhole shaft shall be left six (6) inches, minimum, below subgrade. A heavy metal plate acceptable to the University’s Inspector shall be provided to cover the manhole opening. Cleats shall be provided in at least four (4) points for the underside of the temporary cover to prevent the temporary cover from moving. These cleats shall extend a minimum of 3-inches from the cover plate and shall be welded to the plate.

G. Plywood shall be cut to the shape and size of the manhole base and placed in the base before the temporary cover is placed on the shaft. At the completion of final paving, the installation of grade rings, as necessary, and the installation of the permanent frame and cover assembly shall raise each manhole to final grade.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.7 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping where indicated.

B. Install combination horizontal and manual gate valve type in piping and in manholes where indicated.

C. Install terminal-type backwater valves on end of piping and in manholes where indicated. Secure units to sidewalls.

3.8 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use medium-duty, top-loading classification cleanouts in earth or unpaved foot traffic, and paved foot-traffic areas.
2. Use heavy-duty, top-loading classification cleanouts in service cart or service vehicletraffic service areas.
3. Use extra-heavy-duty, top-loading classification cleanouts in ring mall, fire lanes and roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.9 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside

wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to **grease** interceptors specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.10 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.11 PAINTING

A. Clean and prepare concrete manhole surfaces for field painting. Remove loose efflorescence, chalk, dust, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:

1. Precast Concrete Manholes: All exterior and interior.

B. Prepare ferrous frame and cover surfaces according to SSPC-PA 1 and paint according to SSPC-PA 1 and SSPC-Paint 16. Do not paint surfaces with foundry-applied corrosion-resistant coating.

3.12 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and installation of tracer wire.

1. Use warning tape over all piping.
2. Use detectable tracer wire over nonferrous piping and over edges of underground manholes.

3.13 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.
5. University will run a camera through completed piping to determine if all work is satisfactory. Any defective piping shall be replaced using new material.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of University’s Representative.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of the University Representative and the following:

    a. Allowable leakage is a maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
    b. Close openings in system and fill with water.
    c. Purge air and refill with water.
    d. Disconnect water supply.
    e. Test and inspect joints for leaks.

6. Air Tests: Not allowed unless approved by University's Representative. Test sanitary sewerage according to requirements of UNI-B-6, and the following:

   a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

7. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.14 CLEANING

A. Clean interior of piping of dirt and superfluous material.

END OF SECTION 33 3100

SECTION 33 4100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gravity-flow, non-pressure storm drainage outside the building, with the following components:

1. Backwater valves.
2. Cleanouts.
3. Drains.
4. Precast concrete or Cast-in-place concrete manholes.

1.2 DEFINITIONS

A. PE: Polyethylene plastic.

B. PP: Polypropylene plastic.

C. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Drains.
2. Channel drainage systems.
3. Storage and leaching chambers.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers.
2. Catch Basins and Storm water Inlets: Include plans, elevations, sections, details, and frames, covers, and grates.
3. Storm water Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.

E. Field quality-control test reports.

F. Concrete mix designs: Concrete mix designs reports for poured-in-place manholes and manhole bases.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and storm water inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify University’s Representative no fewer than 14 days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without University Representative's written permission.

1.7 QUALITY ASSURANCE

A. Preinstallation meeting: Conduct conference at Project Site to comply with requirements in Division 01, Section “Project Management and Coordination”.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Or Equal: Where products are specified by manufacturers name and accompanied by the term "or equal", comply with provisions in Division 01, Section 01 6000, “Product Requirements”, Part 2 “Product Substitutions” Article. Specific procedures must be followed before use of an unnamed product or manufacturer.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints. Pipe shall be joined with a bell and spigot joint. The bell shall be an integral part of the pipe. Inside surface of pipe shall be smooth.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

2. Joints shall remain silt-tight when subjected to a 1.5 foot axial misalignment.

2.4 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

B. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.5 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.

b. Fernco Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS Inc.
f. Plastic Oddities, Inc.
g. Or equal.

D. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.
d. Or equal.

E. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1. Manufacturers:

a. Fernco Inc.
b. Logan Clay Products Company (The).
c. Mission Rubber Company; a division of MCP Industries, Inc.
d. Or equal.

F. Nonpressure-Type Rigid Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. ANACO.
b. Or equal.

2.6 BACKWATER VALVES

A. PVC Backwater Valves: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

1. Manufacturers:

a. Canplas Inc.
b. IPS Corporation.
c. NDS Inc.

d. Plastic Oddities, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products.
g. Or equal.

2.7 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Manufacturers:

a. Josam Company.
b. MIFAB Manufacturing, Inc.
c. Smith, Jay R. Mfg. Co.
d. Wade Div.; Tyler Pipe.
e. Watts Industries, Inc.
f. Watts Industries, Inc.; Enpoco, Inc. Div.
g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.
h. Or equal.

2. Top-Loading Classification(s): Heavy duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

1. Manufacturers:

a. Canplas Inc.
b. IPS Corporation.
c. NDS Inc.
d. Plastic Oddities, Inc.

e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Industries, Inc.; Zurn Light Commercial Specialty Plumbing Products.
g. Or equal.

2.12 WALKWAY, PLAZA AND PLANTING AREA DRAINS

A. Gray-Iron Area Drains: ASME A112.21.1M, round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

1. Manufacturers:

a. Josam Company.
b. MIFAB Manufacturing, Inc.
c. Smith, Jay R. Mfg. Co.
d. Wade Div.; Tyler Pipe.
e. Watts Industries, Inc.
f. Zurn Industries, Inc.; Zurn Specification Drainage Operation.
g. Or equal.

2. Top-Loading Classification(s): Medium and heavy duty.

B. Gray-Iron Trench Drains: ASME A112.21.1M, 6-inch- wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular secured grate. Include units of total length indicated and number of bottom outlets with inside calk or spigot connections, of sizes indicated.

1. Manufacturers:

a. Josam Company.
b. Smith, Jay R. Mfg. Co.
c. Wade Div.; Tyler Pipe.
d. Watts Industries, Inc.
e. Zurn Industries, Inc.; Zurn Specification Drainage Operation.
f. Or equal.

2. Top-Loading Classification(s): Medium and heavy duty.

2.13 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105.

1. Form: Sheet or tube.
2. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross laminated PE film of 0.004-inch minimum thickness.
3. Color: Black or Natural.

2.14 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

4. Riser Sections: 4-inch minimum thickness, and lengths to provide required depth approved by University's Representative.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches.
9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
10. Manhole Frames and Covers: Ferrous frame; 30 or 36-inch ID by 6-inch minimum riser with 4-inch- minimum width flange and 32 or 38-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "UCR STORM SEWER."
    a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.

B. Designed Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions required, with provision for sealant joints.

1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole, as required to prevent flotation.
2. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
4. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP], wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 30 inches.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous frame; 30 or 36-inch ID by 6-inch minimum riser with 4-inch- minimum width flange and 32 or 38 -inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "UCR STORM SEWER."

a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.

2.15 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.17 CATCH BASINS

A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
4. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
5. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
6. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 30 inches..
7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.

1. Joint Sealants: ASTM C 990, bitumen or butyl rubber.
2. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
3. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 30 inches.
4. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

C. Cast-in-Place Concrete, Catch Basins: Construct of reinforced concrete; designed according to ASTM C 890 for structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Bottom, Walls, and Top: Reinforced concrete.
2. Channels and Benches: Concrete.
3. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 30 inches.

Retain paragraph and subparagraphs below for rectangular structures.

D. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum, unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.
3. Grates in bicycle pathway shall be suitable for bike tires.
4. Grates in walkways shall have heel proof option.

Retain paragraph and subparagraphs above or paragraph and subparagraph below.

Retain paragraph below for round, manhole-type structures.

E. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26inch- diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.
2. Grates in bicycle pathway shall e suitable for bike tires.
3. Grates in walkways shall have heel proof option.

2.18 STORM WATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to City of Riverside standards.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to City of Riverside standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to City of Riverside standards. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy-duty frames and grates according to City of Riverside standards, except openings shall not affect bike tires.

E. Curb Inlets: Vertical curb opening, of materials and dimensions indicated.

F. Gutter Inlets: Horizontal gutter opening, of materials and dimensions indicated. Include heavy duty frames and grates.

G. Combination Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.

H. Frames and Grates: Dimensions, opening pattern shall be “Bike Tire Proof”, free area, and other attributes indicated or required..

2.19 STORM WATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Storm water Detention Structures: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete, as required to prevent flotation.

2. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
3. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 30 inches.

B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering "UCR STORM SEWER" cast into cover.

2.20 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregular size and shape, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-5, screen opening 5 inches.

2.21 MISCELLANEOUS MATERIALS

A. Paint: SSPC-Paint 16.

B. Warning Tape: Provide non-metallic warning tape shall state “caution storm drain buried below.”

C. PE Sheeting: ASTM D 4397, with at least 8-mil thickness.

D. Foam Pad

1 Waterstops

a Pads shown to be placed between bearing surfaces must either be (1) neoprene complying with the specifications for strip waterstops in section 51-2.05 or (2) commercial quality no. 30 asphalt felt. The protective board is not required for neoprene pads.

b Waterstops must be manufactured from neoprene or PVC. Neoprene must (1) be manufactured from a vulcanized elastomeric compound containing neoprene as the only elastomer and (2) comply with the requirements shown in the following table:

Property	Test method	Requirement
Tensile strength	ASTM D 412	2,000 psi min
Ultimate elongation	ASTM D 412	300 percent min
Compression set, 22 hours at 70 °C	ASTM D 395, Method B	30 percent max
Tear strength	ASTM D 624, Die C	26 kN/m min
Hardness, Type A	ASTM D 2240	55 ± 5
Ozone resistance 20% strain, 100 hours at 100 ± 2.2 °F	ASTM D 1149 except 100 ± 20 parts per 100,000,000	No cracks
Brittleness temperature at -40 °C	ASTM D 746, Procedure B	Pass
Flame propagation	ASTM C 542	Must not propagate flame
Change in volume, IRM 903, immersed 70 hours at 100 °C	ASTM D 471	80 percent max
Change in mass, immersed 7 days at 70 °C	ASTM D 471	15 percent max

c After accelerated aging under ASTM D 573 for 70 hours at 100 degrees C, the elastomer must not show property changes greater than those shown in the following table:

Property	Requirement
Tensile strength	-15 percent
Elongation at break	-40 percent
Hardness	+10 points

d PVC waterstops must (1) be manufactured from PVC complying with CRD-C 572 and (2) comply with the ozone resistance requirement for neoprene. Furnish waterstops full length for straight portions of joints. Manufacturer's shop splices must be fully vulcanized.

2 Strip Waterstops

a The neoprene sheet must comply with the specifications for neoprene in section 51-2.04B. The neoprene adhesive must comply with Federal Specification MMM-A-121. The protective board must be at least 1/2-inch-thick wood or fiberboard that is at least 4 ft long and the width shown. The neoprene sheet must be smooth and free from pin holes or surface blemishes and show no sign of delamination. Surfaces where adhesive is to be applied must have a cloth finish or a buffed finish. Surfaces must be clean and dry when the adhesive is applied.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

a. Shielded flexible or rigid couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:

1. NPS 3 and NPS 6: ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
2. NPS 3 and NPS 15: PVC sewer pipe and fittings, gaskets, and gasketed joints.
3. NPS 8 to NPS 12: Corrugated PE drainage pipe and fittings in NPS 8 and NPS 10 and corrugated PE pipe and fittings in NPS 12, silttight couplings, and coupled joints.
4. NPS 15: Corrugated PE pipe and fittings, silttigh tcouplings, and coupled joints.
5. NPS 15: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless 12inch or smaller pipe size. Use fittings for branch connections unless direct tap into existing storm drain and pipe is twice the size of branch.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated or approved by University Representative.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 36-inch minimum cover.

4. Install hubless cast-iron soil piping according to CISPI C310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install ductile-iron culvert piping according to ASTM A 716.
6. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
7. Install PE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."
8. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
9. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
10. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
11. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Foam Strip Waterstops: Install neoprene sheets as follows:
1. Lap the sheets at least 12 inches.
2. Apply the adhesive to both faces at the manufacturer's recommended rate.
3. Let the adhesive dry to an aggressive tack.
4. Bring the sheets together and roll in both directions to obtain a tight bond.

Abrasive blast clean the concrete surfaces to receive a strip waterstop. Allow the cleaned surfaces to air dry 24 hours before applying the adhesive. Apply the adhesive to the concrete and neoprene sheet at the manufacturer's recommended rate. Let the adhesive dry to an aggressive tack. Apply the sheet to the concrete surface and roll in both directions to obtain a tight bond. Completely cover the installed strip waterstops with 1 layer of protective board attached with adhesive. The protective board must remain in place until backfilling is complete.

3.4 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join corrugated PE piping according to CPPA 100 and the following:

a. Use silttight couplings for Type 1, silttight joints.

6. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomericseal joints or ASTM D 3034 for elastomeric gasket joints.
7. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
8. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.5 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping where indicated or anywhere needed to prevent the backflow of water into a building or depressed area.

B. Install combination horizontal and manual gate valve type in piping and in manholes where indicated.

C. Install terminal-type backwater valves on end of piping and in manholes where indicated.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from storm drain pipe to cleanout at grade. Use cast-iron soil pipe fittings in pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use heavy-duty, top-loading classification cleanouts in earth or unpaved foot traffic and paved foot traffic and vehicle-traffic service areas.
2. Use extra-heavy-duty, top-loading classification cleanouts in roads areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.7 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use heavy-duty, top-loading classification drains in earth or unpaved foot traffic and paved foot traffic, and vehicle-traffic service areas.
2. Use extra-heavy-duty, top-loading classification drains in roads areas.

B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.8 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

F. Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semicircular bottom conforming to the inside contour of the adjacent drainage sections. For changes in direction of drains and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit.

G. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab.

H. For precast concrete construction, make joints between sections with gaskets made for installing joints in concrete piping. Give a smooth finish to the inside joints of precast concrete manholes, curb inlets, and catch basins.

I. Make joints between concrete manholes and pipes entering manholes with the resilient connectors or mortared to produce a watertight joint; install in accordance with the recommendations of the connector manufacturer.

3.9 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes in or required.

B. Set frames and grates to elevations indicated or required.

3.10 STORM WATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete.

B. Construct riprap of broken stone.

C. Install outlets that spill onto grade, anchored with concrete.

D. Install outlets that spill onto grade, with flared end sections that match pipe.

E. Construct energy dissipaters at outlets.

3.11 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.12 DRAINAGE SYSTEM INSTALLATION

A. Assemble and install components according to manufacturer's written instructions.

B. Install with top surfaces of components, except piping, flush with finished surface.

C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

D. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides.

E. Fasten grates to channel sections if indicated.

F. Assemble channel sections with flanged or interlocking joints.

G. Embed channel sections in 4-inch minimum concrete around bottom and sides.

3.13 STORM WATER DISPOSAL SYSTEM INSTALLATION

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill according to piping manufacturer's written instructions.

3.14 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Storm Drainage Piping."

B. Make connections of existing piping and underground structures per City of Irvine junction details. Finish work will conform as nearly as practicable to requirements for new work.

C. Use commercially manufactured wyes for branch connections. Field cutting into piping will not be permitted. Spring wyes into existing line and encase entire wye, plus 6" overlap, with not less than 6" of 3000 psi 28 day compressive strength concrete.

D. For branch connections from side into existing 24" or larger piping, or to underground structures, cut opening into unit sufficiently large to allow 3" of concrete to be packed around entering connection. Cut ends of connection passing through pipe or structure wall to conform to shape and be flush with inside wall, unless otherwise indicated. On outside of pipe structure

wall, encase entering connection in 6" of concrete for minimum length of 12" to provide additional support or collar from connection to undisturbed ground.

E. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

F. Maintain minimum 10 foot separation between PVC piping and any existing direct buried High Temperature Water (HTW) supply and return piping.

G. Connect storm water pumped pressure piping from the building's to the site storm drainage piping. -Pressure piping is specified in Division 22 Section "Storm Drainage Piping." Terminate piping where indicated or as directed by the University's Representative.

1. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into piping, NPS 4 to NPS 20.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting opening into unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.15 PAINTING

A. Clean and prepare concrete manhole surfaces for field painting. Remove loose efflorescence, chalk, dust, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:

1. Cast-in-Place-Concrete Manholes: All exterior, except bottom and all interior.
2. Precast Concrete Manholes: All exterior and interior.

B. Prepare ferrous frame and cover surfaces according to SSPC-PA 1 and paint according to SSPC-PA 1 and SSPC-Paint 16. Do not paint surfaces with foundry-applied, corrosion-resistant coating.

3.16 IDENTIFICATION

A. Materials and their installation are specified in division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape over ferrous piping.
2. Use copper tracer wire over nonferrous piping and over edges of underground structures if system is concealed and could not be located in the future by visual surface structures. Show termination points for tracer wire on Record Drawings.
3. Use detectable warning tape and copper tracer wire over nonferrous piping and over edges of underground structures.

3.17 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.
5. University will run a camera through completed piping to determine if all work is satisfactory. Replace any defective piping using new materials.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems.
3. Schedule tests and inspections by University Representative with at least 48 hours' advance notice.
4. Submit separate report for each test

5. Gravity-Flow Storm Drainage Piping: Test according to requirements of University's Representative, UNI-B-6, and the following:

    a. Option: Test plastic piping according to ASTM F 1417.
    b. Option: Test concrete piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.18 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Any flushing of piping shall be with potable water.

END OF SECTION 33 4100

SECTION 44 5361 - SOLID WASTE COMPACTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid waste compactors.

B. Related Requirements:

1. Section 03 3000 "Cast-in-Place Concrete.
2. Division 26 "Electrical"

1.3 DEFINITIONS

A. WASTEC Rating: The volume of waste material in the charging chamber moved by the ram within the compactor in a single stroke.

1.4 COORDINATION

A. Electrical System Roughing-in: Coordinate layout and installation of onnections to power supplies and control system.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 SUBMITTALS

A. Submittal Compliance Form: If Basis-of-Design products are provided, Submittal Compliance Form may be submitted in lieu of required Product Data submittal and Samples submittal. Ensure compliance with requirements included in Section 01 3300 "Submittal Procedures."

B. Product Data:

1. For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties and accessories, and finishes.

C. Shop Drawings:

1. For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
b. Equipment access points and required space for equipment service and operation.
c. Setting drawings, templates, and instructions for installing anchor bolts and other anchorages.
d. Wiring Diagrams: For power, signal, and control wiring.

D. Qualification Data:

1. For qualified Installer.

E. Product Certificates:

1. For each type of waste compactor, from manufacturer.

F. Field quality-control reports.

G. Operation and Maintenance Data:

1. For waste compactors to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Waste Compactor Standards: Comply with ANSI Z245.2 and with NFPA 82.

C. Waste Bin and Hopper Standard: Comply with ANSI Z245.30.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. WASTEC Rating: 1.31 cu. yd.

B. Feed Opening: 41" x 58".

C. Continuous feeding capability while compactor is operating.

D. Adaptable to special loading systems such as large capacity hoppers, security chutes, or total enclosures.

E. Loading from either ground or dock level.

F. Cycle Time: 33 sec.

G. Total Normal Force: 39.9 tons.

H. Total Maximum Force: 49.5 tons.

I. Ram Penetration: 6 inches.

J. Fire hose connection provided on each unit.

K. Factory testing to ensure leak-proof construction.

L. UL®and CUL®Listed.

M. Motor Size: 10 hp .

N. Electrical Power Supply: 230-460V 3 phase, 60 Hz.

2.2 MANUFACTURERS

A. Marathon RJ250SC or approved equal.

2.3 WASTE COMPACTORS

A. Waste Compactors:

1. Manufacturer's standard self-contained horizontal packaged units with components, options, and accessories needed to comply with requirements and provide complete functional systems.
2. Capacity: 34 cubic yards.
3. Size: 22'-5"x 8'-8"x 8'-5".
4. Controls: CYNCON Cyclic Control System, solid state, automatic container full system.
5. Finish: Manufacturer's standard .
6. Deodorizing Device: Ozone Odor Control system..

B. Number of Extra Storage Containers: Two.

2.4 FABRICATION

A. Fabricate waste compactors with smooth, eased, exposed edges to prevent injury to persons in vicinity of the equipment.

B. Fabricate containers, hoppers, compaction chambers, unit bodies, and similar components of steel with welded joints. Reinforce with steel members sized and spaced to withstand impacts and pressures of normal operations and to prevent deformation.

C. Fabricate equipment with replaceable parts at points of normal wear.

D. Fabricate liquid tight compactor baffles to stop liquid from leaking out.

E. Fabricate diverter to fit chute and properly align with compactor hoppers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, clearances, service rough-ins, and other conditions affecting performance of waste-compactor work.

B. Examine walls and floors for suitable conditions where each waste compactor will be installed.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install each waste compactor according to manufacturer's written instructions, ANSI Z245.2, and ANSI Z245.21 including annexes.

B. Set waste compactors level, plumb, properly aligned, and securely in place. Anchor as required for secure operation.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to ANSI Z245.21, Annex D, "Tests for Evaluation of Equipment and Performance," and manufacturer's written instructions.
2. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.
3. Verify unrestricted access to each firefighting access door or fire port required by ANSI Z245.21 and NFPA 82 for compactor container(s).
4. Verify correct locations, color-coding, and legibility of caution, warning, and danger markings.
5. Certify compliance with test parameters.

C. A waste compactor will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust operating hardware.

B. Touch up marred finishes to factory-finished appearance.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service:

1. Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of waste compactor Installer.

2. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper waste-compactor operation at rated speed and capacity.

3. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

B. Continuing Maintenance Proposal:

1. From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded.

2. State services, obligations, conditions, and terms for agreement period and for future renewal options.

END OF SECTION