TENANT IMPROVEMENT

PROJECT MANUAL

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TENANT IMPROVEMENT

PROJECT MANUAL

SECTION 00 0110

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SECTION 00 5200

AGREEMENT FORM

PART 1 GENERAL

1.01 FORM OF AGREEMENT

1.02 THE AGREEMENT TO BE EXECUTED IS ON FILE WITH THE CONTRACTED PARTIES.

1.03 RELATED REQUIREMENTS

A. Section 00 7200 - General Conditions.

B. Section 00 7300 - Supplementary Conditions.

C. Section 01 4216 - Definitions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 00 5200

SECTION 00 7200

GENERAL CONDITIONS

FORM OF GENERAL CONDITIONS

1.01 THE GENERAL CONDITIONS APPLICABLE TO THIS CONTRACT IS ON FILE WITH THE CONTRACTED PARTIES.

RELATED REQUIREMENTS

2.01 SECTION 00 7300 - SUPPLEMENTARY CONDITIONS.

2.02 SECTION 01 4216 - DEFINITIONS.

SUPPLEMENTARY CONDITIONS

3.01 REFER TO DOCUMENT 00 7300 - SUPPLEMENTARY CONDITIONS FOR AMENDMENTS TO THESE GENERAL CONDITIONS.

END OF SECTION 00 7200

SECTION 00 7300

SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.01 SUMMARY

A. These Supplementary Conditions amend and supplement the General Conditions defined in Document 00 7200 - General Conditions and other provisions of the Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.

B. The terms used in these Supplementary Conditions that are defined in the General Conditions have the meanings assigned to them in the General Conditions.

C. The Supplementaary Conditions applicable to this contract are on file with the contracted parties.

1.02 RELATED SECTIONS

A. Section 01 4216 - Definitions.

1.03 MODIFICATIONS TO GENERAL CONDITIONS

A. Modifications to the General Conditions are on files with the contracted parties.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 00 7300

SECTION 01 1000

SUMMARY

PART 1 GENERAL

1.01 PROJECT

A.

C.

D. The Project consists of the alteration of approximately 112,592 SF of square feet of interior improvements, including office, office support, sound recording studios, and meeting spaces as indicated on the drawings..

1.02 CONTRACT DESCRIPTION

A. The work of each separate prime contract is identified in this section and on Drawings.

1.03 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is indicated on drawings and specified in Section 02 4100.

B. Scope of alterations work is indicated on drawings.

C. Plumbing: Alter existing system and add new construction, keeping existing in operation.

D. HVAC: Alter existing system and add new construction, keeping existing in operation.

E. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.

F. Fire Suppression Sprinklers: Alter existing system and add new construction, keeping existing in operation.

G. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.

H. Telephone: Alter existing system and add new construction, keeping existing in operation.

I. Building Management System: Alter existing system and add new construction, keeping existing in operation.

1.04 WORK BY OWNER

A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items could include:
   1. Movable cabinets.
   2. Furnishings.
   3. Small equipment.
   4. Artwork.
   5. Systems Furniture.
   6. Appliances. Select appliance will be supplied by the Contractor.
   7. IT and Telcom equipment (racks & equipment within racks)

1.05 FUTURE WORK

A. Provide work for future installation of equipment as indicated in the drawings.

1.06 OWNER OCCUPANCY

A. Owner intends to occupy the Project at Substantial Completion, when a Certificates of Occupancy (TCO) is granted by the City of San Diego.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.07 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
   1. The Contractor shall prepare a site logistics plan for approval by Owner. The plan shall include locations of construction trailers, construction parking, laydown areas, proposed access to temporay utilities, and additional information as required by the Owner.

B. Arrange use of site and premises to allow:
   1. Owner occupancy.
   2. Work by Others.
   3. Work by Owner.
   4. Use of site and premises by the public.

C. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

D. Time Restrictions:
   1. Limit conduct of especially noisyespecially noisy, malodorous, and dusty exterior work to times as prescribed by municipal code.
   2. Limit conduct of especially noisy interior work to hours prescribed in contract. .

E. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
   3. Prevent accidental disruption of utility services to other facilities.

1.08 WORK SEQUENCE

A. Coordinate construction schedule and operations with Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 1000

SECTION 01 2100
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cash allowances.

B. Inspecting and testing allowances.

1.02 CASH ALLOWANCES

A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less cost of delivery to site, less applicable taxes.

B. Costs Not Included in Cash Allowances: Product delivery to site and handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing.

C. Architect Responsibilities:
   1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
   2. Select products in consultation with Owner and transmit decision to Contractor.
   3. Prepare Change Order.

D. Contractor Responsibilities:
   1. Assist Architect in selection of products, suppliers, and installers.
   2. Obtain proposals from suppliers and installers and offer recommendations.
   3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
   4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
   5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.

E. Differences in costs will be adjusted by Change Order.

1.03 INSPECTING AND TESTING ALLOWANCES

1.04 ALLOWANCES SCHEDULE

A. Allowances shall be as follows: See the attached list on the next page

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2100

SECTION 01 2200

UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. List of unit prices, for use in preparing Bids.

B. Measurement and payment criteria applicable to Work performed under a unit price payment method.

C. Defect assessment and non-payment for rejected work.

1.02 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the individual specification sections are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

B. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.

C. Assist by providing necessary equipment, workers, and survey personnel as required.

D. Measurement Devices:
   1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
   2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
   3. Metering Devices: Inspected, tested and certified by the applicable state department within the past year.

E. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.

F. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

G. Measurement by Area: Measured by square dimension using mean length and width or radius.

H. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

I. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

J. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.

1.05 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.

B. Payment will not be made for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.

2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.

1.06 DEFECT ASSESSMENT

A. Replace Work, or portions of the Work, not complying with specified requirements.

B. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct one of the following remedies:
   1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Owner.
   2. The defective Work will be partially repaired to the instructions of the Owner, and the unit price will be adjusted to a new unit price at the discretion of Owner.

C. The individual specification sections may modify these options or may identify a specific formula or percentage price reduction.

D. The authority of Owner to assess the defect and identify payment adjustment is final.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2200

SECTION 01 2300

ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

B. Procedures for pricing Alternates.

C. Documentation of changes to Contract Price and Contract Time.

1.02 SCHEDULE OF ALTERNATES

A. Alternate No. 01 - Courtyard Improvements.

1. Scope to include:
    a. 1 - FIXED STRETCHED FABRIC SHADE STRUCTURE AS INDICATED ON SHEET A-401
    b. 2 - UPH3 - OUTDOOR CURTAINS AT L2 COURTYARD GLASS GARAGE DOORS PER FINISH SCHEDULE SHEET - A-112-C
    c. 3 - THERMAL FILM AS INDICATED ON FINISH SCHEDULE, SHEET AF-102-C
    d. 4 - ROOF SCREEN AS INDICATED ON SHEET A-491
    e. 5 - FALL PROTECTION AT EXISTING SKYLIGHTS AND ROOF HATCH A-103 Keynote 6 and 16
    f. 6 - HIGH STC CURTAINS AT SOUND TREATED OFFICES PER FINISH SCHEDULE SHEET A-111-B and A-111-C
    g. 7- ALLOWANCE FOR SPEAKERS IN LOBBY - A-111-B
    h. 8 - LARGE FORMAT PORCELAIN TILE IN LIEU OF SOLID SURFACE WALL PANELS AS INDICATED ON FINISH SCHEDULE, SHEET A-421
    i. 9 - FEATURE SLAT WALL AT STAIR TO WRAP AROUND STAIR AND SURFACE MOUNT TO GYP WALL, SHEET A-402
    j. 10 - EXTERIOR SPEAKERS AT QA PATIO - AS-102 Keynote S6
    k. 11- COMBINATION DRINKING FOUNTAIN/BOTTLE FILLER - ELKAY LZS8WSLP (TOTAL OF THREE)
    l. 12 - PROVIDE FULL HEIGHT PRIVACY FILM (GF-1 SOLYX, ACID ETCH SX3-314) AT ROOMS A2069, A2077 AND A2078

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2300

SECTION 01 2500

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 00 4325 - Substitution Request Form - During Procurement: Required form for substitution requests made prior to award of contract (During procurement).

B. Section 00 6325 - Substitution Request Form - During Construction: Required form for substitution requests made after award of contract (During construction).

C. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.

D. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. The forms indicated in the Project Manual are adequate for this purpose. Information needed for evaluating the Substitution Request includes:
      a. Project Information:
         1) Official project name and number, and any additional required identifiers established in Contract Documents.
         2) Owner's, Architect's, and Contractor's names.

b. Substitution Request Information:
    1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
    2) Indication of whether the substitution is for cause or convenience.
    3) Issue date.
    4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
    5) Description of Substitution.
    6) Reason why the specified item cannot be provided.
    7) Differences between proposed substitution and specified item.
    8) Description of how proposed substitution affects other parts of work.
c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
    1) Physical characteristics.
    2) In-service performance.
    3) Expected durability.
    4) Visual effect.
    5) Sustainable design features.
    6) Warranties.
    7) Other salient features and requirements.
    8) Include, as appropriate or requested, the following types of documentation:
        (a) Product Data:
        (b) Samples.
        (c) Certificates, test, reports or similar qualification data.
        (d) Drawings, when required to show impact on adjacent construction elements.
d. Impact of Substitution:
    1) Savings to Owner for accepting substitution.
    2) Change to Contract Time due to accepting substitution.

D. Limit each request to a single proposed substitution item.
    1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.

B. Submittal Form (before award of contract):
    1. Submit substitution requests by completing the form attached to this section. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submittal Form (after award of contract):
    1. Submit substitution requests by completing the form attached to this section. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. Architect will consider requests for substitutions only within 15 days after date of Agreement.

C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

D. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
3. Bear the costs engendered by proposed substitution of:
    a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
    b. Other construction by Owner.
    c. Other unanticipated project considerations.

E. Substitutions will not be considered under one or more of the following circumstances:
1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
2. Without a separate written request.
3. When acceptance will require revisions to the Contract Documents.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.
1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

3.07 ATTACHMENTS

A. A facsimile of the Substitution Request Form (During Construction) required to be used on the Project is included after this section.

END OF SECTION 01 2500

SECTION 01 3000

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electronic document submittal service.

B. Preconstruction meeting.

C. Site mobilization meeting.

D. Progress meetings.

E. Construction progress schedule.

F. Progress photographs.

G. Coordination drawings.

H. Submittals for review, information, and project closeout.

I. Number of copies of submittals.

J. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.

B. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 PROJECT COORDINATOR

A. Project Coordinator: Construction Manager as specified by the Owner.

B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for pedestrian and vehicular access, traffic, and parking facilities.

C. During construction, coordinate use of site and facilities through the Project Coordinator.

D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 1000 - Summary.

F. Coordinate field engineering and layout work under instructions of the Project Coordinator.

G. Make the following types of submittals to Architect through the Project Coordinator:
   1. Requests for Interpretation.
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Manufacturer's instructions and field reports.
   6. Applications for payment and change order requests.
   7. Progress schedules.
   8. Coordination drawings.
   9. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. Documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. It is Contractor's responsibility to submit documents in allowable format.
   3. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
   4. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
   5. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.

C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
   5. Designation of personnel representing the parties to Contract and Architect.
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

A. Owner will schedule meeting at the Project site prior to Contractor occupancy.
   1. Site Mobilization meeting agenda may be incorporated into first Progress Meeting, at Owner option.

B. Attendance Required:

1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

C. Agenda:
1. Use of premises by Owner and Contractor.
2. Owner's requirements.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Security and housekeeping procedures.
6. Schedules.
7. Application for payment procedures.
8. Procedures for testing.
9. Procedures for maintaining record documents.
10. Requirements for start-up of equipment.
11. Inspection and acceptance of equipment put into service during construction period.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

A. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

B. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

C. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to work.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE

A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.

C. Within 10 days after joint review, submit complete schedule.

D. Submit updated schedule with each Application for Payment.

3.06 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.

C. Photography Type: Digital; electronic files.

D. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.

E. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Structural framing in progress and upon completion.
   2. Completion of partition framing with backing.
   3. Final completion, minimum of ten (10) photos.

F. Take photographs as evidence of existing project conditions as follows:
   1. Interior views: Penetrations through the floors and roof, and elements identified for demolition..
   2. Exterior views: Roof conditions.

G. Views:
   1. Consult with Architect for instructions on views required.
   2. Provide factual presentation.
   3. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

H. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
   4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.07 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

B. Review drawings prior to submission to Architect.

3.08 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.09 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.

2. Certificates.
3. Test reports.
4. Inspection reports.
5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

E. Contractor to conform to all Owner & Tenant Close-Out Procedures.

3.11 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Extra Copies at Project Closeout: See Section 01 7800.

C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

A. General Requirements:
1. Transmit using approved form.
2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
5. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
   a. Deliver submittals to Architect at business address.
6. Schedule submittals to expedite the Project, and coordinate submission of related items.
   a. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 10 working days.
7. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
8. Provide space for Contractor and Architect review stamps.
9. When revised for resubmission, identify all changes made since previous submission.
10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.

11. Submittals not requested will not be recognized or processed.

B. It is the responsibility of the Contractor to coordinate all affected trades.

C. For each submittal for review, allow 10 working days from receipt of complete submittal from Contractor.

3.13 CONTRACTOR RULES AND REGULATIONS WHILE ON SITE

A. See the attached "Contractor Rules and Regulations"

END OF SECTION 01 3000

SECTION 01 3114

FACILITY SERVICES COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Services of a coordinator for facility services construction.

B. Coordination documents.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Responsibilities of separate contractors.

B. Section 01 3000 - Administrative Requirements: Additional requirements for coordination.

C. Section 01 6000 - Product Requirements: Spare parts and maintenance materials.

D. Section 01 7000 - Execution and Closeout Requirements: Starting of Systems. Systems Demonstration.

E. Section 01 7800 - Closeout Submittals: Project record documents.

1.03 MECHANICAL AND ELECTRICAL COORDINATOR

A. Employ and pay for services of a person or firm, technically qualified and administratively experienced in field coordination of the type of work required to be coordinated, for the duration of the Work.

1.04 SUBMITTALS

A. Submit name, address, and telephone number of coordinator and name of principal officer for review.

B. Submit coordination drawings and schedules prior to submitting shop drawings, product data, and samples.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 COORDINATION REQUIRED

A. Coordinate the work listed below:
   1. Fire Suppression: Division 21.
   2. Plumbing: Division 22.
   3. Heating, Ventilating, and Air Conditioning: Division 23.
   4. Electrical: Division 26.
   5. Communications: Division 27.
   6. Electronic Safety and Security: Division 28.

B. Coordinate progress schedules, including dates for submittals and for delivery of products.

C. Conduct meetings among subcontractor and vendors and others concerned, to establish and maintain coordination and schedules, and to resolve coordination matters in dispute.

D. Participate in progress meetings. Report on progress of work to be adjusted under coordination requirements, and any required changes in schedules. Transmit minutes of meetings and reports to concerned parties.

3.02 COORDINATION DOCUMENTS

A. Prepare coordination drawings to organize installation of products for efficient use of available space, for proper sequence of installation, and to identify potential conflicts.

B. Prepare a master schedule identifying responsibilities for activities that directly relate to this work, including submittals and temporary utilities; organize by specification section.

C. Identify electrical power characteristics and control wiring required for each item of equipment.

D. Maintain documents for the duration of the work, recording changes due to site instructions, modifications or adjustments.

E. After Architect review of original and revised documents, reproduce and distribute copies to concerned parties.

3.03 COORDINATION OF SUBMITTALS

A. Review shop drawings, product data, and samples for compliance with Contract Documents and for coordination with related work. Transmit copies of reviewed documents to Architect.

B. Check field dimensions and clearances and relationship to available space and anchors.

C. Check compatibility with equipment and work of other sections, electrical characteristics, and operational control requirements.

D. Check motor voltages and control characteristics.

E. Coordinate controls, interlocks, wiring of switches, and relays.

F. Coordinate wiring and control diagrams.

G. When changes in the work are made, review their effect on other work.

H. Verify information and coordinate maintenance of record documents.

3.04 COORDINATION OF SUBSTITUTIONS AND MODIFICATIONS

A. Review proposals and requests for substitution prior to submission to Architect.

B. Verify compliance with Contract Documents and for compatibility with work of other sections.

C. Submit with recommendation for action.

3.05 OBSERVATION OF WORK

A. Observe work for compliance with Contract Documents.

B. Maintain a list of observed deficiencies and defects; promptly submit.

3.06 DOCUMENTATION

A. Observe and maintain a record of tests. Record:
   1. Specification section number and product name.
   2. Name of Contractor, subcontractor, and vendor.
   3. Name of testing agency and name of inspector.
   4. Name of manufacturer's representative present.
   5. Date, time, and duration of tests.
   6. Type of test, and results.
   7. Retesting required.

B. Assemble background documentation for dispute and claim settlement.

C. Submit copies of documentation to Architect upon request.

3.07 EQUIPMENT START-UP

A. Verify utilities, connections, and controls are complete and equipment is in operable condition as required by Section 01 7000.

B. Observe start-up and adjustments, test run, record time and date of start-up, and results.

C. Observe equipment demonstrations made to Owner; record times and additional information required for operation and maintenance manuals.

3.08 INSPECTION AND ACCEPTANCE OF EQUIPMENT

A. Prior to inspection, verify that equipment is tested, operational, clean, and ready for operation.

B. Assist Architect with review. Prepare list of items to be completed and corrected.

END OF SECTION 01 3114

SECTION 01 3216

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.02 RELATED SECTIONS

A. Section 01 1000 - Summary: Work sequence.

1.03 SUBMITTALS

A. Within 5 days after date of Agreement, submit preliminary schedule.

B. Within 5 days after joint review, submit complete schedule.

C. Submit updated schedule with each Application for Payment.

D. Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by Architect.

E. Submit under transmittal letter form specified in Section 01 3000 - Administrative Requirements.

1.04 SCHEDULE FORMAT

A. Sheet Size: Multiples of 8-1/2 x 11 inches (216 x 280 mm).

B. Scale and Spacing: To allow for notations and revisions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification section number.

C. Identify work of separate stages and other logically grouped activities.

D. Provide sub-schedules for each stage of Work identified in Section 01 1000 - Summary.

E. Provide sub-schedules to define critical portions of the entire schedule.

F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

G. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

1. Ensure adequate durations to include requested mock-ups, review and coordination of shop drawings, and submittal review, revision and re-submittal.

H. Submittal Schedule: Show Contractor submittal dates required for shop drawings, product data, and samples, and product delivery dates; deliver to Architect per approved “Submittal Schedule."

1. Schedule” may be incorporated into construction progress schedule or may be separate, at Contractor's option.

2. Architect's Review Period: Architect will be expedient in review, however, Contractor shall schedule submittals recognizing possibility Architect may reject and may require resubmittal.
3. Contract extension shall not be allowed for Contractor's failure to properly schedule submittals to allow for Architect requiring resubmittal.

I. Indicate delivery dates for owner-furnished products and products identified under Allowances.

J. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.04 REVIEW AND EVALUATION OF SCHEDULE

A. Participate in joint review and evaluation of schedule with Architect at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Update diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

3.06 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION 01 3216

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. References and standards.

C. Testing and inspection agencies and services.

D. Control of installation.

E. Mock-ups.

F. Tolerances.

G. Manufacturers' field services.

H. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 01 2100 - Allowances: Allowance for payment of testing services.

B. Section 01 3000 - Administrative Requirements: Submittal procedures.

C. Section 01 4216 - Definitions.

D. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.

B. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Submit Quality Control plan, identifying all Owner/Tenant/Architect review milestones for requested mock-up and first install items.

C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.
      k. When requested by Architect, provide interpretation of results.
   2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
   2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents.

G. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents.
   2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.05 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.06 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 01 2100; see Section 01 2100 and applicable sections for description of services included in allowance.

B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Contractor Employed Agency:
   1. Inspection agency: Comply with requirements of ASTM D3740, ASTM E329, and _____.
   2. Laboratory: Authorized to operate in the State in which the Project is located.

3. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be a comparison standard for the remaining Work.

D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
3. Provide incidental labor and facilities:
a. To provide access to Work to be tested/inspected.
b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
c. To facilitate tests/inspections.
d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect 30 days in advance of required observations.
1. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION 01 4000

SECTION 01 4100

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY OF REFERENCE STANDARDS

A. Regulatory requirements applicable to this project are the following:

B. 28 CFR 36 - Nondiscrimination by Public Accommodations and in Commercial Facilities; Final Rule; Department of Justice; current edition.

C. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.

D. City of San Diego amendments to some or all of the following.

E. California Fire Code (Part 9 Of Title 24), 2010.

F. NFPA 101 - Life Safety Code; 2015.

G. California Building Code (Part 2 Of Title 24), 2010.

H. California Plumbing Code (Part 5 Of Title 24), 2010.

I. California Mechanical Code (Part 4 Of Title 24), 2010.

J. California Electric Code (Part 3 Of Title 24), 2010.

K. California Elevator Code (Part 7 Of Title 24), 2010.

L. California Energy Code (Part 6 Of Title 24), 2010

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements.

1.03 QUALITY ASSURANCE

A. Contractor's Designer Qualifications: Refer to Section - 01 4000 - Quality Requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 4100

SECTION 01 4216
DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

A. This section supplements the definitions contained in the General Conditions.

B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

A. Furnish: To supply, deliver, unload, and inspect for damage.

B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.

E. Provide: To furnish and install.

F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 4216

SECTION 01 5000

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary telecommunications services.

B. Temporary sanitary facilities.

C. Temporary Controls: Barriers, enclosures, and fencing.

D. Security requirements.

E. Waste removal facilities and services.

F. Project identification sign.

1.02 RELATED REQUIREMENTS

A. Section 01 5100 - Temporary Utilities.

B. Section 01 5213 - Field Offices and Sheds.

C. Section 01 5500 - Vehicular Access and Parking.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

1.04 TEMPORARY UTILITIES - SEE SECTION 01 5100

A. The Contractor shall coordinate temporary utility requirements with the Building Owner and/or the public utility companies providing service.

1.05 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Telecommunications services shall include:

1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
2. Telephone Land Lines: One line, minimum; one handset per line.
3. Internet Connections: Minimum of one; DSL, Cable or T-1 or faster.
4. Facsimile Service: Minimum of one dedicated fax machine/printer, with dedicated phone line.

1.06 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

C. At end of construction, return facilities to same or better condition as originally found.

1.07 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.08 FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.09 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.10 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:
   1. STC rating of 35 in accordance with ASTM E90.
   2. Maximum flame spread rating of 75 in accordance with ASTM E84.

C. Paint surfaces exposed to view from Owner-occupied areas.

1.11 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

B. Coordinate with Owner's security program.

1.12 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 5500

1.13 WASTE REMOVAL

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

C. Provide containers with lids. Remove trash from site as required.

D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 PROJECT IDENTIFICATION

A. Provide project identification sign of design, construction, and location approved by Owner.

B. No other signs are allowed without Owner permission except those required by law.

1.15 FIELD OFFICES - SEE SECTION 01 5213

1.16 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet (600 mm).

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 5000

SECTION 01 5100

TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.02 RELATED REQUIREMENTS

A. Section 01 5000 - Temporary Facilities and Controls:
   1. Temporary telecommunications services for administrative purposes.
   2. Temporary sanitary facilities required by law.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

1.04 UTILITY COORDINATION

A. The Contractor shall coordinate temporary utility requirements with the Owner, Client, and the public utility company providing the service.

1.05 TEMPORARY ELECTRICITY

A. Cost: By Contractor.

B. Connect to Owner's existing power service.
   1. Do not disrupt Owner's need for continuous service.
   2. Exercise measures to conserve energy.
   3. Provide separate metering and reimburse Owner for cost of energy used.

C. Provide temporary electric feeder from existing building electrical service at location as directed.

D. Complement existing power service capacity and characteristics as required.

E. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.

F. Provide main service disconnect and over-current protection at convenient location and meter.

G. Permanent convenience receptacles may be utilized during construction.

H. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.06 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.

B. Provide and maintain 1 watt/sq ft (10.8 watt/sq m) lighting to exterior staging and storage areas after dark for security purposes.

C. Provide and maintain 0.25 watt/sq ft (2.7 watt/sq m) H.I.D. lighting to interior work areas after dark for security purposes.

D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

E. Maintain lighting and provide routine repairs.

F. Permanent building lighting may be utilized during construction.

1.07 TEMPORARY HEATING

A. Provide heating devices and heat as needed to maintain specified conditions for construction operations.

B. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.

C. Existing facilities shall not be used.

1.08 TEMPORARY COOLING

A. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.

B. Maintain maximum ambient temperature of 80 degrees F (26 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.

C. Existing facilities shall not be used.

1.09 TEMPORARY VENTILATION

A. Existing ventilation equipment may not be used.

1.10 TEMPORARY WATER SERVICE

A. Cost of Water Used: By Contractor unless specifically noted otherwise in the Construction Contract.

B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.

C. Connect to existing water source.
   1. Exercise measures to conserve water.
   2. Provide separate metering and reimburse Owner for cost of water used.

D. Extend branch piping with outlets located so water is available by hoses with threaded connections.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 5100

SECTION 01 5213

FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary field offices for use of Architect.

B. Temporary field offices for use of Contractor.

C. Maintenance and removal.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: use of premises and responsibility for providing field offices.

B. Section 01 5000 - Temporary Facilities and Controls:
   1. Temporary telecommunications services for administrative purposes.
   2. Temporary sanitary facilities required by law.

C. Section 01 5500: Parking and access to field offices.

1.03 USE OF EXISTING FACILITIES

A. Existing facilities shall not be used for field offices unless specifically noted otherwise in the Construction Contract. Coordinate the location of the field office with the Owner and Client.

1.04 USE OF PERMANENT FACILITIES

A. When permanent facilities are enclosed with operable utilities, relocate offices into building, with written agreement of Owner, and remove temporary buildings.

PART 2 PRODUCTS

2.01 MATERIALS, EQUIPMENT, FURNISHINGS

A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.02 CONSTRUCTION

A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.

B. Construction: Structurally sound, secure, weather tight enclosures for office. Maintain during progress of Work; remove at completion of Work.

C. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy requirements.

D. Exterior Materials: Weather resistant, finished .

E. Interior Materials in Offices: Sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.

F. Lighting for Offices: 50 fc (538 lx) at desk top height, exterior lighting at entrance doors.

G. Fire Extinguishers: Appropriate type fire extinguisher at each office.

2.03 ENVIRONMENTAL CONTROL

A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

2.04 CONTRACTOR OFFICE AND FACILITIES

A. Size: For Contractor's needs and to provide space for project meetings.

B. Telephone: As specified in Section 01 5000.

C. Furnishings in Meeting Area: Conference table and chairs to seat at least 12 persons; racks and files for Contract Documents, submittals, and project record documents.

1. Meetings with Owner and Architect with more than 12 persons in attendace may use existing facility conference rooms.

D. Other Furnishings: Contractor's option.

E. Equipment: Six adjustable band protective helmets for visitors, one 10 inch (250 mm) outdoor weather thermometer .

2.05 OWNER AND ARCHITECT/ENGINEER OFFICE

A. Minimum four 110 volt duplex convenience outlets, one on each wall.

B. Telephone: As specified in Section 01 5000.

C. Sanitary Facilities: As specified in Section 01 5000.

D. Furnishings:
1. One workstation 60 x 60 inch (1.4 x 1.4 m) in floor dimension.
2. One drafting table 36 x 72 inch (1 x 1.8 m).
   a. Can be shared with contractor's layout tables.
3. One metal, double-door storage cabinet under table.
4. Plan rack to hold working drawings, shop drawings, and record documents.
   a. Can be shared with contractor's layout tables.
5. One swivel arm chairs.
6. One waste basket per desk and table.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.

B. Employee Residential Occupancy: Not allowed on Owner's property.

3.02 MAINTENANCE AND CLEANING

A. Maintain approach walks free of mud, water, and snow.

3.03 REMOVAL

A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION 01 5213

SECTION 01 5500

VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Access roads.

B. Parking.

C. Existing pavements and parking areas.

D. Construction parking controls.

E. Flag persons.

F. Haul routes.

G. Traffic signs and signals.

H. Maintenance.

I. Removal, repair.

J. Mud from site vehicles.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: For access to site, work sequence, and occupancy.

PART 2 PRODUCTS

2.01 MATERIALS

A. Temporary Construction: Contractor's option.

2.02 SIGNS, SIGNALS, AND DEVICES

A. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.

B. Flag Person Equipment: As required by local jurisdictions.

PART 3 EXECUTION

3.01 PREPARATION

A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

3.02 ACCESS ROADS

A. Use of existing on-site streets and driveways for construction traffic is permitted.

B. Tracked vehicles not allowed on paved areas.

C. Location as approved by Owner.

D. Provide unimpeded access for emergency vehicles. Maintain 20 foot (6 m) width driveways with turning space between and around combustible materials.

E. Provide and maintain access to fire hydrants free of obstructions.

3.03 PARKING

A. Use of designated areas of existing parking facilities by construction personnel is permitted.

B. When site space is not adequate, provide additional off-site parking.

C. Locate as indicated by Owner.

3.04 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Owner's operations.

B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.05 FLAG PERSONS

A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.06 HAUL ROUTES

A. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.07 TRAFFIC SIGNS AND SIGNALS

A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

B. Relocate as work progresses, to maintain effective traffic control.

3.08 MAINTENANCE

A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.

B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.09 REMOVAL, REPAIR

A. Repair existing facilities damaged by use, to original condition.

B. Remove equipment and devices when no longer required.

C. Repair damage caused by installation.

3.10 MUD FROM SITE VEHICLES

A. Provide means of removing mud from vehicle wheels before entering streets.

END OF SECTION 01 5500

SECTION 01 5719

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Construction procedures to promote adequate indoor air quality after construction.

B. Building flush-out after construction and before occupancy.

C. Testing indoor air quality before commencement of construction; existing building areas only.

D. Testing indoor air quality after completion of construction.

1.02 PROJECT GOALS

A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
   1. Cleaning of ductwork is not contemplated under this Contract.
   2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
   3. Establish condition of existing ducts and equipment prior to start of alterations.

B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
   1. Furnish products meeting the specifications.
   2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.03 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Testing and inspection services.

B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Section 23 4100 - Particulate Air Filters: HVAC filters

D. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC: Testing HVAC systems for proper air flow rates, adjustment of dampers and registers, and settings for equipment.

1.04 REFERENCE STANDARDS

A. ASTM D5197 - Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology); 2009.

B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.

C. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air; 1990.

D. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air; 1999.

E. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction; 2007.

1.05 DEFINITIONS

A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.

B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.

C. Particulates: Dust, dirt, and other airborne solid matter.

D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
   1. Submit not less than 60 days before enclosure of building.
   2. Identify potential sources of odor and dust.
   3. Identify construction activities likely to produce odor or dust.
   4. Identify areas of project potentially affected, especially occupied areas.
   5. Evaluate potential problems by severity and describe methods of control.
   6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
   7. Describe cleaning and dust control procedures.
   8. Describe coordination with commissioning procedures.

C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.

D. Duct and Terminal Unit Inspection Report.

E. Air Contaminant Test Plan: Identify:
   1. Testing agency qualifications.
   2. Locations and scheduling of air sampling.
   3. Test procedures, in detail.
   4. Test instruments and apparatus.
   5. Sampling methods.

F. Air Contaminant Test Reports: Show:
   1. Location where each sample was taken, and time.
   2. Test values for each air sample; average the values of each set of 3.
   3. HVAC operating conditions.
   4. Certification of test equipment calibration.
   5. Other conditions or discrepancies that might have influenced results.

1.07 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: Independent testing agency having minimum of 5 years experience in performing the types of testing specified.

PART 2 PRODUCTS

2.01 MATERIALS

A. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.

PART 3 EXECUTION

3.01 CONSTRUCTION PROCEDURES

A. Prevent the absorption of moisture and humidity by adsorptive materials by:
   1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
   2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
   3. Provide sufficient ventilation for drying within reasonable time frame.

B. Begin construction ventilation when building is substantially enclosed.

C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.

D. When working in a portion of an occupied building, prevent movement of air from construction area to occupied area.

E. Use of HVAC equipment and ductwork for ventilation during construction is not permitted:
   1. Provide temporary ventilation equivalent to 1.5 air changes per hour, minimum.
   2. Exhaust directly to outside.
   3. Seal HVAC air inlets and outlets immediately after duct installation.

F. Do not store construction materials or waste in mechanical or electrical rooms.

G. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
   1. Inspect duct intakes, return air grilles, and terminal units for dust.
   2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
   3. Clean tops of doors and frames.
   4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
   5. Clean return plenums of air handling units.
   6. Remove intake filters last, after cleaning is complete.

H. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.

I. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

3.02 BUILDING FLUSH-OUT

A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.

B. Perform building flush-out before occupancy.

C. Do not start flush-out until:
   1. All construction is complete.
   2. HVAC systems have been tested, adjusted, and balanced for proper operation.
   3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
   4. New HVAC filtration media have been installed.

D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot (4500 cubic meters per square meter) of floor area has been supplied.
   1. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.
   2. Maintain interior temperature of at least 60 degrees F (15 degrees C) and interior relative humidity no higher than 60 percent.
   3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
   4. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25 percent of the total air volume prior to occupancy, and:
      a. Begin ventilation at least three hours prior to daily occupancy.
      b. Continue ventilation during all occupied periods.
      c. Provide minimum outside air volume of 0.30 cfm per square foot (0.0015 cu m/s/sq m) or design minimum outside air rate, whichever is greater.

E. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

3.03 AIR CONTAMINANT TESTING

A. Contractor's Option: Either full continuous flush-out, or satisfactory air contaminant testing is required, not both.

B. Perform air contaminant testing before starting construction, as base line for evaluation of post-construction testing.

C. Perform air contaminant testing before occupancy.

D. Do not start air contaminant testing until:
   1. All construction is complete, including interior finishes.
   2. HVAC systems have been tested, adjusted, and balanced for proper operation.
   3. New HVAC filtration media have been installed.

E. Indoor Air Samples: Collect from spaces representative of occupied areas:
   1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
   2. Collect samples from height from 36 inches (915 mm) to 72 inches (1830 mm) above floor.
   3. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
   4. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
   5. When retesting the same building areas, take samples from at least the same locations as in first test.

F. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.

G. Analyze air samples and submit report.

H. Air Contaminant Concentration Limits:
   1. Formaldehyde: Not more than 27 parts per billion.
   2. PM10 Particulates: Not more than 50 micrograms per cubic meter.
   3. Total Volatile Organic Compounds (TVOCs): Not more than 500 micrograms per cubic meter.
   4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: Allowable concentrations listed in Table 4-1.
   5. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.

I. Air Contaminant Concentration Test Methods:
   1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6.
   2. Particulates: EPA 600/4-90/010 Method IP-10.
   3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
   4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
   5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.

J. If air samples show concentrations higher than those specified, ventilate with 100 percent outside air and retest at no cost to Owner, or conduct full building flush-out specified above.

END OF SECTION 01 5719

SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations.

E. Procedures for Owner-supplied products.

F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Identification of Owner-supplied products.

B. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

C. Section 01 4000 - Quality Requirements: Product quality monitoring.

D. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

E. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

F. Section 22 0513 - Common Motor Requirements for Plumbing Equipment: Motors for plumbing equipment.

1.03 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators; 2014.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

B. Use of products having any of the following characteristics is not permitted:
   1. Made using or containing CFC's or HCFC's.
   2. Made of wood from newly cut old growth timber.

C. Where other criteria are met, Contractor shall give preference to products that:

1. If used on interior, have lower emissions, as defined in Section 01 6116.
2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
3. Are extracted, harvested, and/or manufactured closer to the location of the project.
4. Have longer documented life span under normal use.
5. Result in less construction waste. See Section 01 7419
6. Are made of vegetable materials that are rapidly renewable.

D. Provide interchangeable components of the same manufacture for components being replaced.

E. Motors: Refer to Section 22 0513 - Common Motor Requirements for Plumbing Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

F. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.

G. Cord and Plug: Provide minimum 6 foot (2 m) cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

A. See Section 01 1000 - Summary for identification of Owner-supplied products.

B. Owner's Responsibilities:
1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
2. Arrange and pay for product delivery to site.
3. On delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

C. Contractor's Responsibilities:
1. Review Owner reviewed shop drawings, product data, and samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 01 6000

SECTION 01 7000

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Owner personnel.

I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.

C. Section 01 4000 - Quality Requirements: Testing and inspection procedures.

D. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.

E. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.

F. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.

G. Section 01 7419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.

H. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

I. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

J. Section 01 9113 - General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.

K. Section 07 8400 - Firestopping.

L. Individual Product Specification Sections:
   1. Advance notification to other sections of openings required in work of those sections.
   2. Limitations on cutting structural members.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.

2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
3. Submit surveys and survey logs for the project record.

C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.
2. Identify demolition firm and submit qualifications.
3. Include a summary of safety procedures.

D. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
1. Structural integrity of any element of Project.
2. Integrity of weather exposed or moisture resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate Contractor.
6. Include in request:
a. Identification of Project.
b. Location and description of affected work.
c. Necessity for cutting or alteration.
d. Description of proposed work and products to be used.
e. Alternatives to cutting and patching.
f. Effect on work of Owner or separate Contractor.
g. Written permission of affected separate Contractor.
h. Date and time work will be executed.

E. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 QUALIFICATIONS

A. For demolition work, employ a firm specializing in the type of work required.
1. Minimum of 5 years ofdocumented experience.

B. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

C. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.

D. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.06 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
   2. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.

H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
   1. Pest Control Service: As required treatments.

I. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

A. See Section 01 1000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
2. Grid or axis for structures.
3. Building foundation, column locations, ground floor elevations.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.

B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.
2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
2. Remove items indicated on drawings.
3. Relocate items indicated on drawings.
4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.

2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    b. See Section 01 1000 for other limitations on outages and required notifications.
    c. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
3. Where a change of plane of 1/4 inch (6 mm) or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
1. Complete the work.
2. Fit products together to integrate with other work.
3. Provide openings for penetration of mechanical, electrical, and other services.
4. Match work that has been cut to adjacent work.

5. Repair areas adjacent to cuts to required condition.
6. Repair new work damaged by subsequent work.
7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to specified condition.

E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

J. Patching:
1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials, or as manufacturer recommends.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Prohibit traffic from landscaped areas.

H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate with requirements of Section 01 9113 - General Commissioning Requirements

B. Coordinate schedule for start-up of various equipment and systems.

C. Notify Architect and Owner seven days prior to start-up of each item.

D. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

E. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

F. Verify that wiring and support components for equipment are complete and tested.

G. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

I. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. See Section 01 7900 - Demonstration and Training.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous and conform with manufacturer recommendations.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Clean filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Owner will occupy portions of the building as specified in Section 01 1000.

F. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

H. Accompany Project Coordinator on Contractor's preliminary final inspection.

I. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

J. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION 01 7000

SECTION 01 7230

BRACING AND ANCHORING

PART 1GENERAL

1.01 SECTION INCLUDES

A. Guidelines and limitations for supporting all mechanical, electrical, plumbing or architectural items from the building structure, and for seismic bracing for all such items.

B. The design and installation of all bracing and anchoring all mechanical, electrical, plumbing, fire protection systems except as noted or otherwise indicated.

1.02 RELATED SECTIONS

A. Section 01 3000 - Administrative Requirements: Deferred submittal requirements for drawings and calculations.

B. Section 01 3114 - Facility Services Coordination: Coordination requirements for facility services.

C. Section 06 4100 - Architectural Wood Casework: Bracing and anchoring for cabinets.

D. Division 11: Bracing and anchoring for equipment.

E. Division 12: Bracing and anchoring for furniture.

F. Division 22: Plumbing support devices.

G. Division 23: Mechanical support devices.

H. Division 26: Electrical support devices.

1.03 DESIGN REQUIREMENTS

A. Design of bracing and anchoring is not required for items for which the contract documents provide specific details of bracing and anchoring.

B. Design anchoring and bracing according to the current California Building Code (CBC) requirements.

C. Design seismic bracing according to the Chapter 16 and ASCE Standard 7-10 Chapter 13 seismic design requirements for nonstructural components using the following force criteria:
   1. Seismic Design Category = D
   2. Ip = Importance Factor
      a. Importance Factor = 1.5 for the following components:
         1) Fire protection sprinkler systems.
         2) Emergency Generator and transfer switches providing power to life safety systems.
         3) Systems or components containing hazardous materials.
      b. Importance Factor = 1.0 for all other components.
   3. SDS = 0.752
   4. ap = Per Table 13.6-1
   5. Rp = Per Table 13.6-1

D. Seismic bracing and anchoring is not required for components referenced in ASCE 7-10 Chapter 13 as follows:
   1. Components exempted in Section 13.1.4.
   2. Architectural components complying with Section 13.5.1 Exceptions.
   3. Mechanical and electrical components complying with Section 13.6.1 Exceptions.
   4. HVAC ductwork complying with Sections 13.6.7.a or 13.6.7.b.
   5. Piping systems complying with Sections 13.6.8.1 or 13.6.8.2.

E. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design system anchoring so that resultant forces do not over stress the building structure.

1.04 QUALITY ASSURANCE:

A. Perform design and prepare shop drawings under the direct supervision of a Professional Structural Engineer experienced in the design of this work and licensed in California.

B. For seismic bracing for mechanical, electrical and plumbing systems, refer to the current edition of Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" for guidelines.

1.05 SUBMITTALS:

A. Submit shop drawings indicating layout of bracing and anchoring, anchor and brace locations, substructures and attachment methods. Submit calculations and details for each anchor and brace type, indicating all resultant forces applied to the structure. Calculations will be reviewed for compliance with design criteria.

B. Submit proposed alternative methods of attachment for review and approval by the Architect, prior to deviating from the requirements given below.

PART 2PRODUCTS

2.01 MATERIALS:

A. Furnish all substructures and fasteners required to comply with the limitations given below. Use materials as specified in the various sections and as appropriate to the use.

B. Channel framing systems: As specified in Section 05 5000.

C. All exterior materials: hot dipped galvanized or stainless steel.

PART 3EXECUTION

3.01 GUIDELINES & LIMITATIONS

A. The General Contractor shall coordinate the load requirements from subcontractors so that no combination of loads exceeds the limitations given below.

B. Wood Structure:
   1. Support no loads from plywood deck or 2 x roof rafters.
   2. Attach no loads greater than the following without specific approval of Architect.
      a. Roof purlins: 150 lbs. point load. For multiple loading submit drawings for Architect's review.
      b. Roof girder: 300 lbs. points load. 600 lbs. total for a single span.
   3. Place all fasteners for hanger support within the middle 1/3 of the member depth.
   4. Total loads suspended from the roof structure shall not exceed the design loading of 6.0 lbs/square foot.

3.02 INSTALLATION

A. Install bracing and anchoring systems to allow for proper access to mechanical and electrical equipment and devices.

B. Install seismic bracing so as not to ground out vibration and sound isolation items.

END OF SECTION 01 7230

SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
   1. Aluminum and plastic beverage containers.
   2. Corrugated cardboard.
   3. Wood pallets.
   4. Clean dimensional wood.
   5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 1000 - Site Clearing for use options.
   6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
   7. Glass.
   8. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (http://flooring.dupont.com) and Interface (www.interfaceinc.com) conduct reclamation programs.
   9. Paint.

E. The following recycling incentive programs are mandatory for this project; Contractor is responsible for implementation:
   1. Cityy of San DIego Construction and Demolition (C&D) Debris Deposit Ordinance: Rebates and credits must be applied for by Owner and shall accrue to Owner.

F. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.

G. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.
   5. Incineration, either on- or off-site.

H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: List of items to be salvaged from the existing building for relocation in project or for Owner.

B. Section 01 3000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. Section 01 5000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

D. Section 01 6000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

E. Section 01 7000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

F. Section 31 1000 - Site Clearing: Handling and disposal of land clearing debris.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.

d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

4. Recycled and Salvaged Materials: Include the following information for each:
   a. Identification of material, including those retrieved by installer for use on other projects.
   b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
   c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
5. Material Reused on Project: Include the following information for each:
   a. Identification of material and how it was used in the project.
   b. Amount, in tons or cubic yards (cubic meters).
   c. Include weight tickets as evidence of quantity.
6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

C. Recycling Incentive Programs:
   1. Where revenue accrues to Contractor, submit copies of documentation required to qualify for incentive.
   2. Where revenue accrues to Owner, submit any additional documentation required by Owner in addition to information provided in periodic Waste Disposal Report.

PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. See Section 01 6000 - Product Requirements for substitution submission procedures.

B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 6000:
   1. Relative amount of waste produced, compared to specified product.
   2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
   3. Proposed disposal method for waste product.
   4. Markets for recycled waste product.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 1000 for list of items to be salvaged from the existing building for relocation in project or for Owner.

B. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.

D. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.

E. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings, particularly at:
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.
   4. Job safety meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. As a minimum, provide:
      a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
      b. Separate dumpsters for each category of recyclable.
      c. Recycling bins at worker lunch area.
   2. Provide containers as required.
   3. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.
   4. Locate enclosures out of the way of construction traffic.
   5. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   6. If an enclosed area is not provided, clearly lay out and label a specific area on-site.
   7. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 01 7419

SECTION 01 7800

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.
   7. Maintain one posted paper set of record documents; and one set as an electronic PDF document posted to an approved electronic transfer site.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

E. Verify with Owner, Tenant and Architect whether Operations and Maintenance electronic submittal is acceptable.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

G. Provide servicing and lubrication schedule, and list of lubricants required.

H. Include manufacturer's printed operation and maintenance instructions.

I. Include sequence of operation by controls manufacturer.

J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

K. Provide control diagrams by controls manufacturer as installed.

L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

O. Include test and balancing reports.

P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Manual: Bind in commercial quality 8-1/2 by 11 inch (216 by 279 mm) three D side ring binders with durable plastic covers.

F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION 01 7800

SECTION 01 7900

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Training of Owner personnel in operation and maintenance is required for:
   1. HVAC systems and equipment.
   2. Items specified in individual product Sections.

B. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.

B. Section 01 9113 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.

C. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.

B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Commissioning Authority for review and inclusion in overall training plan.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.

2. Sign-in sheet showing names and job titles of attendees.
3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
4. Include Commissioning Authority's formal acceptance of training session.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TRAINING - GENERAL

A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.

B. Conduct training on-site unless otherwise indicated.

C. Owner will provide classroom and seating at no cost to Contractor.

D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.

G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
1. The location of the O&M manuals and procedures for use and preservation; backup copies.
2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
3. Typical uses of the O&M manuals.

I. Product- and System-Specific Training:
1. Review the applicable O&M manuals.
2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
4. Provide hands-on training on all operational modes possible and preventive maintenance.
5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 01 7900

SECTION 01 9113

GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
   1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
   4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.

B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.

C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

D. The Commissioning Authority is employed by Owner.

1.02 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

B. Fire Supression Systems
   1. Pre-action sprinkler system.

C. Plumbing Systems:
   1. Water heaters.
   2. Booster pumps.

D. HVAC System, including:
   1. Major and minor equipment items.
   2. Piping systems and equipment.
   3. Ductwork and accessories.
   4. Terminal units.
   5. Control system.
   6. Sound control devices.
   7. Vibration control devices.
   8. Variable frequency drives.
   9. Computer room air conditioners.

E. Electrical Systems:
   1. Power quality.
   2. Emergency power systems.
   3. Uninterruptible power systems.
   4. Lighting controls other than manual switches.

F. Electronic Safety and Security:
   1. Security system, including doors and hardware.
   2. Fire and smoke alarms.

G. Communications:
   1. Voice and data systems.
   2. Audio visual systems.

H. Building Management Systems:
   1. Building management systems and controls.

I. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

J. Indoor Air Quality Procedures: The Commissioning Authority will coordinate; Contractor will execute; see Section 01 5719 - Temporary Environmental Controls.

1.03 RELATED REQUIREMENTS

A. Section 01 5719 - Temporary Environmental Controls: Precautions and procedures; smoking room testing; building flush-out.

B. Section 01 7000 - Execution and Closeout Requirements: General startup requirements.

C. Section 01 7800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

D. Section 01 7900 - Demonstration and Training: Scope and procedures for Owner personnel training.

E. Section 01 9114 - Commissioning Authority Responsibilities.

F. Section 23 0800 - Commissioning of HVAC: HVAC control system testing; other requirements.

1.04 REFERENCE STANDARDS

A. CSI/CSC MF - Masterformat; 2016.

B. PECI (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests; Current Edition.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
   1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F (0.3 degree C) and resolution of plus/minus 0.1 degree F (0.05 degree C).
   2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
   3. Calibration: According to the manufacturer’s recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.

C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
   1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

A. Commissioning Authority will prepare the Commissioning Plan.
   1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
   2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

B. Contractor is responsible for compliance with the Commissioning Plan.

C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
   1. Commissioning will be phased (by floors, for example) to minimize the total construction time.

D. Commissioning Schedule:
   1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
   2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
   3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
   4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 DOCUMENTATION IDENTIFICATION SYSTEM

A. Give each submitted form or report a unique identification; use the following scheme.

B. Type of Document: Use the following prefixes:
   1. Startup Plan: SP-.
   2. Startup Report: SR-.
   3. Prefunctional Checklist: PC-.
   4. Functional Test Procedure: FTP-.
   5. Functional Test Report: FTR-.

C. System Type: Use the first 4 digits from CSI/CSC MF (Master Format), that are applicable to the system; for example:
   1. 2300: HVAC system as a whole.
   2. 2320: HVAC Piping and Pumps.
   3. 2330: HVAC Air Distribution.

D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.

E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.

F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

3.03 STARTUP PLANS AND REPORTS

A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.

B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.

C. Submit directly to the Commissioning Authority.

3.04 PREFUNCTIONAL CHECKLISTS

A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
   1. No sampling of identical or near-identical items is allowed.
   2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
   3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
      a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
      b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
      c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
      d. Serial number of installed unit.
      e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer’s start-up checklist items and minor testing.
      f. Sensor and actuator calibration information.
   4. A preliminary list of Prefunctional Checklists is attached, to indicate anticipated scope.
   5. PECI (Samples) found at http://www.peci.org/library/mcpgs.htm indicate anticipated level of detail for Prefunctional Checklists.

B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
   1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
   2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
   3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
   4. If any Checklist line item is not relevant, record reasons on the form.
   5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
   6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
   7. Submit completed Checklists to Commissioning Authority within two days of completion.
   8. See Section 01 7000 - Execution and Closeout Requirements for additional general startup requirements.

C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
   1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
   2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
   3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
   4. When asked to review the proposed Checklists, do so in a timely manner.

D. Commissioning Authority Witnessing: Required for:
   1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
   2. A sampling of non-primary equipment, as allowed by the commissioning plan.

E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
   1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.05 FUNCTIONAL TESTS

A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.

B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.

C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.

D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
   1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
   2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
   3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
   4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
   5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:
   1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
   2. Examples of Functional Testing:
      a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
      b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
      c. Systems are run through all the HVAC control system’s sequences of operation and components are verified to be responding as the sequence's state.

d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.

3. A preliminary list of Functional Tests is attached, to indicate anticipated scope.
4. PECI (Samples) found at http://www.peci.org/library/mcpgs.htm indicated anticipated level of detail for Functional Tests.

F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

G. Factory Tests: Commissioning Authority and Contractor are responsible for coordinating testing of equipment at the factory by factory personnel, to ensure compliance with commissioning requirements.

H. Field Tests By Others: Where Functional Tests are indicated as to be performed by others not subject to the Contract Documents, those tests are not subject to these commissioning requirements.

3.06 SENSOR AND ACTUATOR CALIBRATION

A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.

C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
2. Verify that sensors with shielded cable are grounded only at one end.
3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
4. Tolerances for critical applications may be tighter.

D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
3. If not, install offset, calibrate or replace sensor.

E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
2. Connect a signal generator in place of sensor.
3. Connect ammeter in series between transmitter and building automation system control panel.
4. Using manufacturer’s resistance-temperature data, simulate minimum desired temperature.
5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
8. Reconnect sensor.

9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
11. If not, replace sensor and repeat.
12. For pressure sensors, perform a similar process with a suitable signal generator.

F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
2. Pressure, Air, Water, Gas: 3 percent of design.
3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).
4. Relative Humidity: 4 percent of design.
5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
6. Flow Rate, Air: 10 percent of design.
7. Flow Rate, Water: 4 percent of design.
8. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).
9. Hot Water Coil and Boiler Water Temperature: 1.5 degrees F (0.8 degrees C).
10. Cooling Coil, Chilled and Condenser Water Temperatures: 0.4 degrees F (0.2 degree C).
11. Natural Gas and Oil Flow Rate: 1 percent of design.

G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
4. Command valve/damper to open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
2. Use an ultra-sonic flow meter to detect flow or leakage.

3.07 TEST PROCEDURES - GENERAL

A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
2. Sampling is not allowed for:
   a. Major equipment.
   b. Life-safety-critical equipment.
   c. Prefunctional Checklist execution.
3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.

4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
7. If YY percent of the units in the second sample fail, test all remaining identical units.
8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.

F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.

G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.

H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.

I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority’s request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
2. Other points will be monitored by the Commissioning Authority using dataloggers.
3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
5. Graphical output is desirable and is required for all output if the system can produce it.
6. Monitoring may be used to augment manual testing.

3.08 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 7800 - Closeout Submittals for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION 01 9113

SECTION 01 9114

COMMISSIONING AUTHORITY RESPONSIBILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Authority's responsibilities for commissioning:
   1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests performed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed O&M data submittals are specified.
   4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is specified.

B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.

C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.

D. The Commissioning Authority is employed by Owner.

E. Contractor's responsibilities are defined in Section 01 9113 - General Commissioning Requirements.

1.02 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

B. Fire Supression Systems
   1. Pre-action sprinkler system.

C. Plumbing Systems:
   1. Water heaters.
   2. Booster pumps.

D. HVAC System, including:
   1. Major and minor equipment items.
   2. Piping systems and equipment.
   3. Ductwork and accessories.
   4. Terminal units.
   5. Control system.
   6. Sound control devices.
   7. Vibration control devices.
   8. Variable frequency drives.
   9. Computer room air conditioners.

E. Electrical Systems:
   1. Power quality.
   2. Emergency power systems.
   3. Uninterruptible power systems.
   4. Lighting controls other than manual switches.

F. Electronic Safety and Security:
   1. Security system, including doors and hardware.
   2. Fire and smoke alarms.

G. Communications:
   1. Voice and data systems.
   2. Audio visual systems.

H. Building Management Systems:
   1. Building management systems and controls.

I. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

J. Indoor Air Quality Procedures: The Commissioning Authority will coordinate; Contractor will execute; see Section 01 5719 - Temporary Environmental Controls.

1.03 REFERENCE STANDARDS

A. ASHRAE Guideline 1.1 - The HVAC&R Technical Requirements for the Commissioning Process; 2007, with Errata (2012).

B. CSI/CSC MF - Masterformat; 2016.

C. PECI (MCP) - Model Commissioning Plan; Current Edition.

1.04 SUBMITTALS

A. Commissioning Plan:
   1. Submit preliminary draft for review by Owner and Architect within 10 days after commencement of Commissioning Authority contract.
   2. Submit final plan not more than 15 days after commencement of construction, for issuance to all parties.

B. List of Prefunctional Checklists to be developed:
   1. Submit preliminary list at start of construction documents phase or within 10 days after commencement of contract, whichever is later.
   2. Submit final list 30 days after start of construction.

C. Prefunctional Checklists:
   1. Submit preliminary draft at start of construction documents phase or within 10 days after commencement of contract, whichever is later.
   2. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.

D. List of Functional Test procedures to be developed:
   1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit final list not more than 30 days after start of construction.

E. Functional Test Procedures:
   1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.

F. Training Plan.

G. Recommissioning Manual: Submit within 60 days after receipt of Owner's instructions to proceed with preparation.

H. Commissioning Record: Submit to Contractor for inclusion with O&M manuals.

I. Final Commissioning Report: Submit to Owner.

PART 2 PRODUCTS

2.01 DOCUMENTATION IDENTIFICATION SYSTEM

A. Give each submitted form or report a unique identification; use the following scheme.

B. Type of Document: Use the following prefixes:
   1. Commissioning Plan: CP-.
   2. Prefunctional Checklist: PC-.
   3. Functional Test Procedure: FTP-.
   4. Functional Test Report: FTR-.
   5. Commissioning Report: CR-.

C. System Type: Use the first 4 digits from CSI/CSC MF (Master Format), that are applicable to the system; for example:
   1. 2300: HVAC system as a whole.
   2. 2320: HVAC Piping and Pumps.
   3. 2330: HVAC Air Distribution.

D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.

E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.

F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

A. Prepare and maintain the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
   1. Call and chair meetings of the Commissioning Team when appropriate.
   2. Give Contractor sufficient notice for scheduling commissioning activities.
   3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
   4. Commissioning will be phased (by floors, for example) to minimize the total construction time.
   5. PECI (MCP) may be used as a guide for the Commissioning Plan.
   6. ASHRAE Guideline 1.1 may be used as a guide for the Commissioning Plan.
   7. Avoid replication of information included in the construction contract documents to the greatest extent possible.

B. Basis of Design Documentation: Detailed documentation of the functional requirements of the project; descriptions of the systems, components, and methods chosen to meet the design intent; assumptions underlying the design intent.
   1. Copy to be furnished to Commissioning Authority for use in preparation of the commissioning plan.

C. Review the construction contract documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of the Commissioning Authority in preparing the Commissioning Plan.

D. Commissioning Schedule:
   1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.
   2. Contractor's scheduling responsibilities are specified in the construction contract documents.
   3. Revise and re-issue schedule monthly.

4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.

E. Commissioning Team: Project manager or other designated person of:
1. Owner's building or plant operation staff.
2. Commissioning Authority.
3. Design professional's design team.
4. General Contractor.
5. HVAC subcontractor.
6. HVAC control system subcontractor.
7. Electrical subcontractor.
8. Plumbing subcontractor.
9. Communications subcontractor.
10. Building Controls subcontractor.
11. Security subcontractor.
12. Other subcontractors who will be required to perform commissioning activities.

3.02 CONSTRUCTION CONTRACT DOCUMENTS

A. General Commissioning Specifications: Architect has prepared general commissioning specifications for inclusion in the construction contract documents; review and submit comments to Owner.
1. These specifications include:
a. Procedures applicable to all types of items to be commissioned.
b. General commissioning procedures for HVAC.
c. General commissioning procedures for electrical.
d. General commissioning procedures for plumbing.
e. General commissioning procedures for communications.
f. General commissioning procedures for integrated automation.
2. Prepare specifications for any of the following that would be recommended, for incorporation into the construction contract documents by Architect:
a. Additional Contractor submittals needed for purposes of commissioning, such as startup procedures, draft test procedures, draft training plans, etc.
b. Additional Owner personnel training.
c. Additional operation or maintenance data that should be submitted.

B. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
2. The Checklist forms are intended to be part of the Contractor's Contract Documents.

C. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by Owner and Architect.
1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.
2. The forms the Commissioning Authority will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.

D. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction contract documents.

E. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction contract documents

3.03 PREFUNCTIONAL CHECKLISTS

A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup.
   1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
   2. Identify each Checklist by using the contract documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.
   3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
   4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
   5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
   6. Include line items for each physical inspection to be performed.
   7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.
   8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.
   9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.

B. Prefunctional Checklists - Format:
   1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
   2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.
   3. Include on the cover sheet, above the signature block, the following statement: "The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two checkboxes:
      a. "This Checklist is submitted for approval with no exceptions."
      b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
   4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
   5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

3.04 FUNCTIONAL TEST PROCEDURES

A. Develop test procedures in sufficient detail to show that functional performance is in accordance with the Contract Documents and shows proper operation through all modes of operation where there is a different system response, including seasonal, unoccupied, warm-up, cool-down, part- and full-load.
   1. Obtain assistance and review by installing subcontractors.
   2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.

3. Include test setup instructions, description of tools and apparatus, special cautions, and.
4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing.
6. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.

B. Functional Test Report Forms: Prepare forms in advance of testing, using a consistent format; include all test procedure information given to Contractor and:
1. Report Identifier (see Documentation Identification Scheme).
2. Test prerequisites.
3. Formulas to be used in calculations.
4. Yes/No check boxes for each step of test.
5. Space to record results, document deficiencies, and make recommendations.
6. Signature and date block for Commissioning Authority.

C. Functional Test Prerequisites: Include space to verify all of the following items on each Functional Test Report Form, unless truly inapplicable:
1. All related equipment has been started up and start-up reports and Prefunctional Checklists submitted and approved ready for Functional Testing.
   a. For hydronic systems, check that:
      1) Piping system flushing is complete and required report approved.
      2) Water treatment system is complete and operational.
      3) Test and balance (TAB) is complete and approved.
2. All control system functions for this and all interlocking systems are programmed and operable in accordance with the Contract Documents, including final set points and schedules with debugging, loop tuning and sensor calibrations completed, with space for signature of controls installer.
3. Incomplete items identified by Architect during closeout inspections have been corrected or completed.
4. Safeties and operating ranges have been reviewed.
5. A copy of the specified sequence of operation is attached.
6. A copy of applicable schedules and setpoints is attached.
7. A copy of the specified Functional Test Procedures is attached.
8. The Functional Test Procedures have been reviewed and approved by the applicable installer.
9. Vibration control report approved (if required).
10. False loading equipment, system and procedures ready.
11. Sufficient clearance around equipment for servicing.
12. Original values of pre-test setpoints that need to be changed to accommodate testing have been recorded, with a check box provided to verify return to original values (include control parameters, limits, delays, lockouts, schedules, etc.).
13. Any other items on the Prefunctional Checklist or Start-up Reports that need to be re-verified.

3.05 CONSTRUCTION PHASE

A. Coordinate the commissioning work with Contractor and Construction Manager; ensure that commissioning activities are being incorporated into the master schedule.

B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.

C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review commissioning activities and responsibilities with all parties involved. Require attendance by all members of the Commissioning Team.

D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and Owner personnel; hold meetings at least monthly.

E. Submit periodic progress reports to Owner and Contractor.

F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that Owner's responsibilities are clearly defined in warranties.

G. Review and approve submittals directly related to commissioning.

H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.

I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.

J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.

K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.

L. HVAC Commissioning:
   1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
   2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
   3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
   4. Review TAB Plan prepared by Contractor.
   5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.
   6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.
   7. Analyze trend logs and monitoring data to verify performance.
   8. Prepare a standard trend logging package of primary parameters that will provide Owner's operations staff clear indications of system function in order to identify proper system operation and trouble shoot problems; provide any additional information needed to interpret the trend logs.

M. Witness and document testing of systems and components over which the Commissioning Authority does not have direct control, such as smoke control systems, tests contracted directly by Owner, and tests by manufacturer’s personnel; include documentation in O&M manuals.

N. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Authority rather than the Contractor, perform such testing without assistance of Contractor.

O. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.

P. O&M Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.

Q. Notify Contractor and Owner of deficiencies in procedures or results; suggest solutions.

3.06 TRAINING

A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.

1. Include a 1 hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.
2. Include a 1 hour session by the Commissioning Authority on the use of the blank Prefunctional Checklists and Functional Test report forms for re-commissioning purposes.
3. Establish criteria for determining satisfactory completion of training.

B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.

3.07 CLOSEOUT

A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.
1. Include the Final Commissioning Plan and Final Report.
2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
a. Design intent documentation, furnished by Architect or others.
b. Detailed operational sequences.
c. Startup plan and approved startup reports.
d. Filled out Prefunctional Checklists.
e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
f. Training plan and training records.
g. Recommissioning recommendations, including time schedule and procedures; include blank copies of all Prefunctional Checklists and Functional Test report forms.

B. Final Commissioning Report: Include:
1. Executive summary.
2. List of participants and roles.
3. Brief facility description.
4. Overview of commissioning scope and general description of testing and verification methods.
5. For each item commissioned, an evaluation of adequacy of:
a. The product itself; i.e. compliance with the contract documents.
b. Installation.
c. Functional performance; include a brief description of the verification method used and observations and conclusions from the testing.
d. O&M documentation, including design intent.
e. Operator training.
6. List of all outstanding non-compliance items, referenced to the specific functional test, inspection, trend log, etc., where the deficiency is documented.
7. List of unresolved issues, seasonal or deferred testing, and other concerns that could affect facility operation.
8. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. (about four to six pages).
9. Attach appendices containing all commissioning documentation, including logs, minutes, reports, deficiency lists, communications, findings, etc., except that specified to be part of the Commissioning Record.

C. Recommissioning Manual: Revise the Commissioning Plan documents, checklists, and Functional Test forms as necessary based on accepted recommendations of the final Commissioning Report. Provide step-by-step instructions for recommissioning, blank forms, and cross-references to O&M data needed during recommissioning.

3.08 POST-OCCUPANCY PHASE

A. Coordinate deferred and seasonal Functional Tests; verify correction of deficiencies.

B. On-Site Review: 10 months after Substantial Completion conduct on-site review with Owner's staff.

1. Review the current facility operation and condition of outstanding issues related to the original and seasonal commissioning.
2. Interview staff to identify problems or concerns they have operating the facility as originally intended.
3. Make suggestions for improvements and for recording these changes in the O&M manuals.
4. Identify areas of concern that are still under warranty or are the responsibility of the original construction contractor.
5. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

END OF SECTION 01 9114

SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of building elements for alteration purposes.

C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 1000 - Summary: Sequencing and staging requirements.

C. Section 01 1000 - Summary: Description of items to be removed by Owner.

D. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

E. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

F. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

G. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of the existing building as indicated in the drawings.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with other requirements specified in Section 01 7000.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.

5. Provide, erect, and maintain temporary barriers and security devices.
6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
8. Do not close or obstruct roadways or sidewalks without permit.
9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

C. Do not begin removal until receipt of notification to proceed from Owner.

D. Do not begin removal until built elements to be salvaged or relocated have been removed.

E. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.

F. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.

G. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

H. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

I. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Comply with requirements of Section 01 7419 - Waste Management.
2. Dismantle existing construction and separate materials.
3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

1. Verify that construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Removed and Reinstalled
1. Items:Items to be salvaged are indicated in Section 01 1000.
2. Clean and repair items to functional condition adequate for intended reuse.
3. Protect items from damage during transport and storage.
4. Inventory items removed. Submit inventory of items to Architect.
5. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

C. Separate areas in which demolition is being conducted from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.
2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.

D. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

E. Remove existing work as indicated and as required to accomplish new work.
1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
2. Remove items indicated on drawings.

F. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. See Section 01 1000 for other limitations on outages and required notifications.
4. Verify that abandoned services serve only abandoned facilities before removal.
5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

G. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 - Waste Management.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 4100

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Floors and slabs on grade.

C. Concrete reinforcement.

D. Joint devices associated with concrete work.

E. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 033511 Concrete Floor Finishes

B. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

C. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).

D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).

E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.

F. ACI 305R - Hot Weather Concreting; 2010.

G. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).

H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.

I. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.

J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016, with Editorial Revision (2016).

K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.

L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.

M. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.

N. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.

O. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.

P. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.

Q. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes; 2001 (Reapproved 2012).

R. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.

S. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2010.

T. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2014.

U. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.

V. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2014.

W. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008).

X. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric); 2014.

Y. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.

Z. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

AA. COE CRD-C 48 - Method of Test for Water Permeability of Concrete; 1992.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

D. Samples: Submit samples of underslab vapor retarder to be used.

E. Samples: Submit two, 12 inch (305 mm) long samples of waterstops and construction joint devices.

F. Test Reports: Submit report for each test or series of tests specified.

G. Sustainable Design Submittals: If any wood or wood-based form materials, including supports, are permanently installed in the project, submit documentation required for sustainably harvested wood as specified in Section 01 6000 - Product Requirements.

H. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

I. Project Record Documents: Pending Owner approval of the cost, accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
   1. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Do not install concrete when temperatures are below 40 degrees F.

1.06 MOCK-UP

A. Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish.
   1. Panel Size: As directed by the Architect.
   2. Locate: as directed by the Architect.

B. If requested by the Architect, the cast concrete mock-up might be integrated with other building components in order to see material finishes together as well as certain connection details.

C. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.
   3. Finish: Galvanized in accordance with ASTM A767/A767M, Class I, unless otherwise indicated.
   4. Finish: Epoxy coated in accordance with ASTM A775/A775M, unless otherwise indicated.

B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
   1. Form: Coiled Rolls.
   2. WWR Style: 4 x 8-W6 x W10 (102 x 203-MW39 x MW65).

C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch (1.29 mm).
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches (38 mm) of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, [Type I - Normal] Portland type.
   1. Acquire cement for entire project from same source.

B. Cement in direct contact with soil per the Soils Report: ASTM C150/C150M, Type V - High Sulfate Resistance Portland type.

C. Fine and Coarse Aggregates: ASTM C33/C33M.
   1. Acquire aggregates for entire project from same source.

D. Fly Ash: ASTM C618, Class C or F.

E. Calcined Pozzolan: ASTM C618, Class N.

F. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

G. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

H. Where exposed concrete is intended to match existing concrete, make every effort to match the materials in order to achieve a color match.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
   1. Manufacturers:
      a. Euclid Chemical Company; PLASTOL 6420: www.euclidchemical.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

C. Water Reducing Admixture: ASTM C494/C494M Type A.
   1. Manufacturers:
      a. Euclid Chemical Company; EUCON NW: www.euclidchemical.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
   1. Installation: Comply with ASTM E1643.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
   3. Manufacturers:
      a. Fortifiber Building Systems Group; Moistop Ultra 15: www.fortifiber.com/#sle.
      b. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com/#sle.
      c. Stego Industries, LLC; Stegp Wrap Vapor Barrier (15-Mil): www.stegoindustries.com/#sle.
      d. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): www.wrmeadows.com/#sle.
      e. Substitutions: See Section 01 6000 - Product Requirements.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Height Change, Plastic State; when tested in accordance with ASTM C827/C827M:
      a. Maximum: Plus 4 percent.
      b. Minimum: Plus 1 percent.
   3. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).
   4. Products containing aluminum powder are not permitted.
   5. Flowable Products:
      a. Dayton Superior Corporation; Sure-Grip High Performance Grout: www.daytonsuperior.com/#sle.
      b. Dayton Superior Corporation; Sure-Grip Precision Grout: www.daytonsuperior.com/#sle.
      c. Dayton Superior Corporation; 1107 Advantage Grout: www.daytonsuperior.com/#sle.
      d. Dayton Superior Corporation; Multipurpose Grout: www.daytonsuperior.com/#sle.
      e. Kaufman Products Inc; SureGrout: www.kaufmanproducts.net/#sle.
      f. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; DURAGROUT: www.laticrete.com/our-products/concrete-construction-chemicals/#sle.
      g. SpecChem, LLC; SC Precision Grout: www.specchemllc.com/#sle.
      h. W. R. Meadows, Inc; 588-10K: www.wrmeadows.com/#sle.
      i. W. R. Meadows, Inc; 1428 HP: www.wrmeadows.com/#sle.
      j. Substitutions: See Section 01 6000 - Product Requirements.
   6. Low-Slump, Dry Pack Products:

a. Dayton Superior Corporation; Dri Pak Precast Grout: www.daytonsuperior.com/#sle.
b. Dayton Superior Corporation; Turbo Grout HP 12: www.daytonsuperior.com/#sle.
c. Five Star Products, Inc; Five Star Grout: www.fivestarproducts.com/#sle.
d. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Duragrout: www.lmcc.com/#sle.
e. The QUIKRETE Companies; QUIKRETE® FastSet™ Non-Shrink Grout: www.quikrete.com/#sle.
f. SpecChem, LLC; SC Multipurpose Grout: www.specchemllc.com/#sle.
g. Substitutions: See Section 01 6000 - Product Requirements.

C. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
1. Minimum Compressive Strength at 7 days, ASTM C579: 12,000 pounds per square inch (82.7 MPa).
2. Manufacturers:
a. Euclid Chemical Company; E3-DEEP POUR: www.euclidchemical.com/#sle.
b. Dayton Superior Corporation; Epoxy Grout J55: www.daytonsuperior.com/#sle.
c. Dayton Superior Corporation; Pro-Poxy 2000 NS: www.daytonsuperior.com/#sle.
d. Dayton Superior Corporation; Pro-Poxy 2000 DP: www.daytonsuperior.com/#sle.
e. Five Star Products, Inc; Five Star DP Epoxy Grout: www.fivestarproducts.com/#sle.
f. Five Star Products, Inc; Five Star HP Epoxy Grout: www.fivestarproducts.com/#sle.
g. SpecChem, LLC; SpecPoxy Grout: www.specchemllc.com/#sle.
h. Substitutions: See Section 01 6000 - Product Requirements.

2.06 BONDING AND JOINTING PRODUCTS

A. Epoxy Bonding System:
1. Complying with ASTM C881/C881M and of Type required for specific application.
2. Manufacturers:
a. Adhesives Technology Corporation; Crackbond SLV-302, Crackbond LR-321, Crackbond LR-321 LPL, Ultrabond 2100 LPL, Ultrabond 2100, Ultrabond 1, Ultrabond 2, or Ultrabond HS200: www.atcepoxy.com/#sle.
b. Adhesives Technology Corporation; Crackbond LR-321 G, or Miracle Bond 1450: www.atcepoxy.com/#sle.
c. Euclid Chemical Company; DURAL FAST SET LV: www.euclidchemical.com/#sle.
d. Euclid Chemical Company; DURALFLEX GEL: www.euclidchemical.com/#sle.
e. Euclid Chemical Company; DURALFLEX LV: www.euclidchemical.com/#sle.
f. Euclid Chemical Company; DURAL 452 GEL, DURAL 452 LV, or DURAL 452 MV: www.euclidchemical.com/#sle.
g. Dayton Superior Corporation; Slow Set Bonding Agent: www.daytonsuperior.com/#sle.
h. Dayton Superior Corporation; Perma Prime 3C: www.daytonsuperior.com/#sle.
i. Kaufman Products Inc; SurePoxy HM EPL: www.kaufmanproducts.net/#sle.
j. Kaufman Products Inc; SurePoxy HM Class B: www.kaufmanproducts.net/#sle.
k. SpecChem, LLC; SpecPoxy 1000, SpecPoxy 2000, SpecPoxy 3000, or SpecPoxy 3000FS: www.specchemllc.com/#sle.
l. W. R. Meadows, Inc; Rezi-Weld Gel Paste, Rezi-Weld Gel Paste State, Rezi-Weld 1000: www.wrmeadows.com/#sle.
m. Substitutions: See Section 01 6000 - Product Requirements.

B. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
1. Manufacturers:
a. W. R. Meadows, Inc; Speed-E-Joint: www.wrmeadows.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.

C. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches (150 mm) on center; ribbed steel stakes for setting.
   1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
   2. Height: To suit slab thickness.
   3. Manufacturers:
      a. BoMetals, Inc; _____: www.bometals.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

D. Dowel Sleeves: Plastic sleeve for smooth, round, steel load-transfer dowels.
   1. Manufacturers:
      a. BoMetals, Inc; _____: www.bometals.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.07 CURING MATERIALS

A. When approved by the Architect, curing materials may be used. Proposed curing agents must be compatible with finish floor systems. It is the responsiblility of the Contractor to research and demonstrate with documentation that the systems are compatible.

B. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
   1. Manufacturers:
      a. Dayton Superior Corporation; AquaFilm Concentrate J74: www.daytonsuperior.com/#sle.
      b. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com/#sle.
      c. W. R. Meadows, Inc; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

C. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
   1. Product dissipates within 4 to 6 weeks.
   2. Provide product containing fugitive red dye.
   3. Manufacturers:
      a. Dayton Superior Corporation; Resin Cure with Dye J11WD: www.daytonsuperior.com/#sle.
      b. Dayton Superior Corporation; Clear Resin Cure J11W: www.daytonsuperior.com/#sle.
      c. Dayton Superior Corporation; Clear Cure VOC J7WB: www.daytonsuperior.com/#sle.
      d. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC: www.euclidchemical.com/#sle.
      e. W. R. Meadows, Inc; 1100-Clear: www.wrmeadows.com/#sle.
      f. Substitutions: See Section 01 6000 - Product Requirements.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
   1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:

1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
4. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.
5. Cement Content: Minimum ___ pounds per cubic yard (___ kg per cu m).
6. Water-Cement Ratio: Maximum 40 percent by weight.
7. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
8. Maximum Slump: 3 inches (75 mm).
9. Maximum Aggregate Size: 5/8 inch (16 mm).

2.09 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on the drawings and in conformance with the Soils Report. Pursuant to ACI 302.1R, do not use sand over the vapor retarder.
   2. Ensure that the installation of the vapor retarder membrane and granular fill under the slab-on-grade meet all requirements of the drawings (in particular, architectural and structural) and requirements of the soils report.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Install reinforcing steel pusuant to the requirements of Section 03 2000 - Concrete Reinforcing.

B. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect not less than 24 hours prior to commencement of placement operations.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. For slabs on-grade, contraction joints shall be 1/8" wide and 1" deep for 4" thick slabs; (or 1/4 the slab thickness). Any proposed joint locations shall be reviewed with the Architect and shall not exceed 12'-0" on center in both directions.

C. Anchor joint fillers and devices to prevent movement during concrete placement.

D. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

E. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.

F. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs for compliance with specified tolerances.

B. Insofar as many companies within the the resilient flooring industry still use the old method of determining floor flatness as a prerequisite for the flooring substrate, the following criteria is provided. The maximum variation of surface flatness required under this method is as noted below:
   1. Exposed Concrete Floors: 1/4 inch (6 mm) in 10 feet (3 m).
   2. Under Seamless Resilient Flooring: 1/8 inch (3 mm) in 10 feet (3 m).
   3. Under Carpeting: 1/4 inch (6 mm) in 10 feet (3 m).

C. Correct the slab surface if tolerances are less than specified.

D. Concrete floor slabs shall meet the following ACI FF and FL criteria for flatness and levelness. Meeting criteria established by the resilient flooring industry will be the responsibility of the finish floor supplier/installer. Floor grinding and the use of floor leveling materials might be necessary to achieve substrate requirements for the finish flooring.

E. The American Concrete Institute recommends the use of F(F) Floor Flatness and F(L) Floor Levelness Minimums. Minimums for this project for slabs on-grade are as follows:
   1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15.

F. F(F) Floor Flatness for elevated slabs with camber shall be as follows. F(L) Floor Levelness minimums do not apply to slabs with camber.
   1. Under Thick-Bed Tile: F(F) of 20; before removing shoring.
   2. Under Carpeting: F(F) of 25; before removing shoring.
   3. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; before removing shoring.

G. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.

H. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

I. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE TOLERANCES

A. Concrete work shall maintain tolerances required by ACI 117, unless otherwise indicated. Concrete shall achieve ACI 117 tolerances including:
   1. Formed surfaces over distances of 10 ft: +/- 0.3%; (which is approx. 3/8" in 10'.)
   2. Formed Outside corner of exposed corner column: +/- 0.2%.
   3. Formed surface irregularities (gradual or abrupt)
      a. Exposed concrete surfaces shall conform to: Class A (+1/8" in 5'.)
      b. Concealed concrete surfaces shall conform to: Class B (+1/4" in 5'.)

3.08 CONCRETE FINISHING

A. Surface Vapor Reduction Coating: If authorized, coordinate and apply the Surface Vapor Reduction Coating to slabs which will require its use in order to meet the requirements for the installation of the finish flooring.

B. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, and thin set ceramic tile.
   2. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be polished and all other exposed slab surfaces.
      a. Steel-Reinforced Plastic Trowel Blade Manufacturer: Wagman Metal Products, Inc: www.wagmanmetal.com/#sle.

C. In areas with floor drains (i.e. Toilet Rooms), floor slab shall be flat with a 1% slope within 2' of the drain.

D. In basement shower areas, the structural slab-on-grade shall slope 1% minimum to the drain.

E. Concrete Polishing: See Section 033543

3.09 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
   2. High early strength concrete: Not less than four days.

C. Formed Surfaces: Cure by moist curing. Remove formwork within 24 hours.

D. Protection of Formed Wall Surfaces from Concrete Construction Overhead: Provide protection of constructed concrete wall surfaces from overhead construction through the use of polyethlene plastic sheets (visqueen) or other types of water resistant barriers. Every effort shall be made to keep liquid cement from be dripped on previously placed concrete work.

E. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. Initial Curing: If curing agent has not been applied, start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
      a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
      b. Spraying: Spray water over floor slab areas and maintain wet.

c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.

3. Final Curing: Begin after initial curing but before surface is dry.
   a. Moisture-Retaining Sheet: Lap strips not less than 3 inches (75 mm) and seal with waterproof tape or adhesive; secure at edges.

3.10 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.

F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

G. Slab Testing: Cooperate with manufacturer of specified moisture vapor reduction admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

3.11 PROTECTION

A. Restrict traffic over unprotected concrete floor surface until fully cured.

B. Protect exposed formed concrete surfaces from overhead construction. Drip lines or stains from concrete work above is not accetable on vertical concrete surfaces.

END OF SECTION 03 3000

SECTION 03 3511

CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.
   1. Polished Concrete System
   2. Polished and Stained Concrete System

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

B. Section 03 3000 - Cast-in-Place Concrete: Curing compounds that also function as sealers.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 MOCK-UP

A. Mock-Up Size: 10 feet (3 m) square.

B. Locate where directed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.07 WARRANTY

A. Polished Concrete: Pursuant to the requirements of Section 017000 Execution and Closeout.

B. Polished and Stained Concrete: Pursuant to the requirements of Section 017000 Execution and Closeout.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

A. Polished Concrete System: Locate where indicated on the drawings.

B. Polished and Stained Concrete System: Locate where indicated on the drawings.
   1. Exposed Concrete EC-1, provide as indicated in the drawings.
   2. Exposed Concrete EC-2, provide as indicated in the drawings.

2.02 DENSIFIERS AND HARDENERS

A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete prior to set.
   1. Products:
      a. Ameripolish, Inc; 3D HS Hybrid Silicate Densifier: www.ameripolish.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 COATINGS

A. Concrete Stain or Dye: Translucent, penetrating compound for interior or exterior use; must be finished with a topical sealer.
   1. Products:

a. Ameripolish, Inc; Surelock Concrete Dye: www.ameripolish.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.

B. Penetrating Sealer: Transparent, non-yellowing, water- or solvent-based coating.
1. Products:
a. Ameripolish, Inc; 3D SP Concrete Sealer: www.ameripolish.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 POLISHED CONCRETE SYSTEM

A. Polished Concrete System: Materials, equipment, and procedures designed and furnished by a single manufacturer to produce dense polished concrete of the specified sheen.
1. Acceptable Systems:
a. Ameripolish, Inc; Ameripolish Polished Concrete System: www.ameripolish.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.03 CONCRETE POLISHING

A. Execute using materials, equipment, and procedures specified by manufacturer, using manufacturer approved installer.

B. 'Polished Concrete' and 'Polished and Stained Concrete' shall match existing finishes in the building. Coordinate with the Architect as to which existing floor areas within the building shall be used as the sample for intended finishes.

C. Both the 'Polished Concrete' and 'Polished and Stained Concrete' shall receive a stain protective sealer.

END OF SECTION 03 3511

SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Miscellaneous steel brackets or connectors.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 05 5213 - Pipe and Tube Railings.

C. Section 09 9113 - Exterior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.

E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.

H. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2014, with Editorial Revision (2015).

I. ASTM B85/85M - Standard Specification for Aluminum-Alloy Die Castings; 2014.

J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

K. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

L. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2012.

M. ASTM B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric); 2012.

N. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.

O. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.

P. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

Q. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

R. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.

S. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

T. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

U. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2008.

V. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

W. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

X. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.

E. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

F. Slotted Channel Fittings: ASTM A1011/A1011M.

G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 (ASTM B210M), 6063 alloy, T6 temper.

D. Aluminum-Alloy Bars: ASTM B211 (ASTM B211M), 6061 alloy, T6 temper.

E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.

F. Aluminum-Alloy Die Castings: ASTM B85/B85M.

G. Bolts, Nuts, and Washers: Stainless steel.

H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of miscellaneous steel support structures; prime paint finish.

B. Door Frames for Overhead Door Openings and Wall Openings: Channel, Angle, and tube sections; prime paint finish.

C. Toilet Partition Suspension Members: Steel channel sections; prime paint finish.

D. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

E. Steel framing and supports for countertops. Steel sections and tubing; prime paint finish.

F. Steel framing and supports for mechanical and electrical equipment .

G. Steel framing and supports for applications where framing and supports are not specified in other Sections.

2.05 FINISHES - STEEL

A. Prime paint steel items.
   1. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.06 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Class I color anodized.

B. Interior Aluminum Surfaces: To match adjacent aluminum fabrication finishes. Contractor to field verify adjacent aluminum fabrication finishes.

2.07 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).

C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).

D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).

E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION 05 5000

SECTION 05 7300

DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Railing and guardrail assemblies.

B. Wall-mounted handrails.

C. Free-standing railings at steps.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Supports.

B. Section 09 2116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

B. ASTM B138/B138M - Standard Specification for Manganese Bronze Rod, Bar, and Shapes; 2011 (Reapproved 2017).

C. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.

D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.

E. AWS C 3.4/C3.4M - Specification for Torch Brazing; 2007.

F. AWS C3.5M/C 3.5 - Specification for Induction Brazing; 2007.

G. AWS C3.9M/C3.9 - Specification for Resistance Brazing; 2009.

H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

I. AWS D1.6 - Structural Welding Code - Stainless Steel; 1999.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
   1. Contractor.
   2. Architect.
   3. Owner's representative.
   4. Other subcontractors of adjacent work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.

C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.

D. Samples: Submit samples of handrail & base channel.

E. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.
   1. Certificates: Submit California licensed civil or structural engineer certification indicating railings comply with Contract Documents and code requirements.

F. Manufacturer's Installation Instructions.

G. Maintenance Data: Manufacturer's instructions for care and cleaning.

H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing glazed railing systems and acceptable to manufacturer.

B. Mock-ups: Construct a railing of each type specified. Locate mock-ups where directed. Mockups may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver railing materials in factory provided protective coverings and packaging.

B. Protect railing materials against damage during transit, delivery, storage, and installation at site.

C. Inspect railing materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

D. Prior to installation, store materials and components under cover, in a dry location.

1.08 FIELD CONDITIONS

A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C).

B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C) for 24 hours before, during, and after railing installation.

1.09 WARRANTY

A. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Decorative Metal Railings:

B. Railing Components:
   1. Manufacturer/Fabricator specified for railings.
   2. C. R. Laurence Co., Inc: www.crlaurence.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 RAILING SYSTEMS

A. Railings - General: Factory- or shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.
   1. Design Criteria: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set; loads do not need to be applied simultaneously.
      a. Lateral Force: 75 lb (333 N) minimum, at any point, when tested in accordance with ASTM E935.
      b. Distributed Load: 50 pounds per foot (0.73 kN per m) minimum, applied in any direction at the top of the handrail, when tested in accordance with ASTM E935.
      c. Concentrated Loads on Intermediate Rails: 50 pounds per square ft (0.22 per sq m), minimum.
      d. Concentrated Load: 200 pounds (888 N) minimum, applied in any direction at any point along the handrail system, when tested in accordance with ASTM E935.
         1) Top Rails or Handrail if No Top Rail: Design to support minimum 300 lb. concentrated single point load applied at any point vertically or horizontally.

e. Access: Comply with California Building Code and Americans with Disabilities Act Accessibility Guidelines requirements for railing design to provide access for persons with disabilities.
f. Code: Comply with requirements of applicable codes for railing design, except where more restrictive codes are specified.

2. Assembly: Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets.
3. Joints: Tightly fitted and secured, machined smooth with hairline seams.
4. Field Connections: Provide sleeves to accommodate site assembly and installation.
5. Welded and Brazed Joints: Make exposed joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
   a. Ease exposed edges to small uniform radius.
   b. Welded Joints:
      1) Carbon Steel: Perform welding in accordance with AWS D 1.1/D1.1M.
      2) Stainless Steel: Perform welding in accordance with AWS D 1.6.
   c. Brass/Bronze Brazed Joints:
      1) Perform torch brazing in accordance with AWS C3.4/3.4M.
      2) Perform induction brazing in accordance with AWS C3.5/3.5M.
      3) Perform resistance brazing in accordance with AWS C3.9/3.9M

B. Base Mount Railing System: Engineered, base supported railing system with structural glass.

C. Wall-Mounted Handrail:

2.03 MATERIALS

A. Stainless Steel Components:
   1. ASTM A666, Type 304.
   2. Stainless Steel Tubing: 16 gage (0.0625 inch) (1.59 mm), 1-1/2 inch (38 mm) diameter.
   3. Stainless Steel Finish: No. 4 Satin.

B. Bronze Components: ASTM B138/B 138M.
   1. Bronze finished to match Chemetal #925 Brushed Medium Bronze nonmagnetic corrosion resistant; ASTM A269 seamless tubing or ASTM A666 for sheet and plate.
   2. Bronze Finish: BHMA 630 (US32D) satin bronze or NAAMM Number 4, directional polished satin finished bronze.

C. Glass: ASTM C1048, Kind FT, select glazing quality clear tempered safety glass, unless otherwise indicated.
   1. Thickness: 1/2 inch (13 mm).
   2. Configuration: As indicated on drawings.
   3. Edges: Ground smooth and polished.
      a. edges polished prior to tempering
   4. Color: As selected by Architect.
   5. Tong Marks: Provide tempered glass with no tong marks; upon special approval by Architect, tong marks fully concealed in finish construction may be permitted

D. Steel Components: ASTM A36.

E. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron ASTM A47, or cast steel ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.

F. Grout: Non-shrink meeting ASTM C1107, non-metallic, pre-mixed, factory-packaged, non-staining, non-corrosive; type specifically recommended by manufacturer as applicable to job condition.
   1. Manufacturers:
      a. Master Builders/Masterflow 713.
      b. U.S. Grout Corp./Five Star Grout.

c. Bostik Construction Products/Upcon Grout.
d. Protex Industries, Inc./Propak.
e. Substitutions: Refer to Section 01630.

G. Brackets and Anchors: Unexposed steel plates, angles and supports shall be steel; exposed items satin finished aluminum.

H. Brackets and Anchors: Unexposed plates, angles and supports may be steel; exposed items to match ornamental metal type and finish.

I. Fasteners: Type required for specific usage; provide concealed fasteners except where specifically approved; where exposed match type and finish of metal being fastened.

2.04 ACCESSORIES

A. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.

C. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
1. For anchorage to concrete, provide inserts to be cast into concrete for bolting anchors.
2. For anchorage to masonry, provide brackets to be embedded in masonry for bolting anchors.
3. For anchorage to stud walls, provide backing plates for bolting anchors.
4. Exposed Fasteners: No exposed bolts or screws.

D. Hydraulic Expansion Cement: ASTM C1107/C1107M.

E. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch (0.4 mm) dry film thickness per coat..

F. Sealant: Silicone; As selected by Architect.

G. Finish Touch-Up Materials: As recommended by manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION

A. Protect existing work.

B. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.

C. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

D. Coordinate setting of anchorages that are to be embedded in substrates.

3.03 INSTALLATION

A. Comply with manufacturer's drawings and written instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.

C. Anchor securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Prior to securing continuous items, adjust to ensure proper matching at butt joints and correct alignment throughout their length.

F. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.05 FIELD QUALITY CONTROL

A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.06 CLEANING

A. Remove protective film from exposed metal surfaces.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances.

3.07 PROTECTION

A. Protect installed components and finishes from damage after installation.

B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
   1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION 05 7300

SECTION 05 7500

DECORATIVE FORMED METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior fabrications made of formed metal sheet, secondary supports, and anchors to structure, including:
   1. Closures, trim, and filler panels.
   2. Lighting coves.
   3. Mullion cladding.
   4. Pockets for window treatment.
   5. Exposed brackets for shelving
   6. Column wraps.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Non-decorative metal fabrications.

B. Section 07 6200 - Sheet Metal Flashing and Trim: Formed metal flashings and trim.

C. Section 09 9123 - Interior Painting.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

C. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.

D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015b.

E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).

G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

H. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

I. ASTM C834 - Standard Specification for Latex Sealants; 2014.

J. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

K. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

L. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.

M. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2011).

N. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.

O. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2007.

P. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.

Q. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

R. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel; 2004.

S. SSPC-SP 1 - Solvent Cleaning; 2015.

T. SSPC-SP 5 - White Metal Blast Cleaning; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data - Sheet Metal Material: 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.
   4. Specimen warranty.

C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Show actual field measurements on shop drawings.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the fabrications must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at an appropriate scale.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, minimum size 12 inches (305 mm) square, representing actual product in color and texture.

F. Maintenance Data: Care of finishes and warranty requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of any accumulated water.
   4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).
   5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 FORMED METAL FABRICATIONS - GENERAL

A. Shop Assembly: Preassemble items to greatest extent possible. Minimize field splices and field assembly. Disassemble only as necessary for transportation and handling. Mark items clearly for assembly and installation.

B. Coordination: Match dimensions and attachment of formed metal items to adjacent construction. Produce integrated assemblies. Closely fit joints; align edges and flat surfaces unless indicated otherwise.

C. Forming: Profiles indicated. Maximize lengths. Fold exposed edges to form hem indicated or ease edges to radius indicated with concealed stiffener. Provide flat, flush surfaces without cracking or grain separation at bends.

D. Reinforcement: Increase metal thickness; use concealed stiffeners, backing materials or both. Provide stretcher leveled standard of flatness and stiffness required to maintain flatness and hold adjacent items in flush alignment.

E. Anchors: Straps, plates and anchors as required to support and anchor items to adjacent construction.

F. Supports: Miscellaneous framing, mounting, clips, sleeves, fasteners and accessories required for installation.

G. Welding and Brazing: Weld or braze joints continuously. Grind, fill or dress to produce smooth, flush, exposed surfaces. Do not discolor metal. Grind smooth, polish, and restore damaged finishes to required condition.

H. Performance Requirements:
   1. Thermal Movements:
      a. Allow for thermal movements in exterior metal fabrications due to temperature changes. Prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
      b. Temperature Change Range: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), on material surfaces.
   2. Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

2.02 FORMED METAL FABRICATIONS - SHEET METAL

A. Closures, Trim and Fill Panels:
   1. Form closures from type and thickness of metal indicated.
   2. Conceal fasteners when possible.
   3. Drill and tap holes for securing to other surfaces.
   4. Provide gaskets where indicated or needed for continuous seal at adjacent surfaces.
   5. Miter or cope at corners and reinforce with bent metal plate. Form tight joints.

B. Lighting Coves: Form lighting coves from type and thickness of metal indicated. Provide cutouts for electrical wiring and fasteners. Coordinate size of coves, cutouts and anchoring system with lighting system shown on drawings.

C. Mullion Cladding: Form mullion cladding from type and thickness of metal indicated. Fit tightly to adjacent constructions.

D. Pockets for Window Treatment:
   1. Form pockets from metal of type and thickness indicated. Coordinate dimensions and attachment method with window treatment, window frames, ceiling system and other adjacent construction.
   2. Reinforce for attaching window treatment and hardware.
   3. Divide continuous pockets with built in partitions. Separate adjoining drapery and blind units, align with window mullions and accommodate filler panel at ends of pocket.

2.03 MATERIALS

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections exposed to view on finished units.

B. Aluminum Sheet: ASTM B209 or ASTM B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.

C. Stainless Steel Sheet: ASTM A240/A240M.

D. Stainless Steel Sheet: ASTM A666, Type 304; stretcher-leveled.

E. Fasteners, MCM Panels:
   1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
   2. Screws: Self-drilling or self-tapping ASTM A276/A276M, Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
   3. Bolts: Stainless steel.

F. Gaskets: As required to seal joints in decorative formed metal and remain airtight; as recommended in writing by decorative formed metal manufacturer.
   1. ASTM D1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
   2. Closed-cell polyurethane foam, adhesive on two sides, release paper protected.

G. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 15 mil (0.4 mm) dry film thickness per coat.

H. Joint Sealer, Exterior: ASTM C920; elastomeric silicone sealant; of type, grade, class, and use classifications required to seal joints in decorative formed metal and remain weathertight; and as recommended in writing by decorative formed metal manufacturer.

I. Joint Sealer, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C834; of type and grade required to seal joints in decorative formed metal; as recommended in writing by decorative formed metal manufacturer and with a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

J. Sound Deadening Materials:
   1. Insulation: Unfaced, mineral-fiber blanket insulation; ASTM C665, Type I, and passing ASTM E136 test.
   2. Mastic: ASTM D1187/D1187M; cold-applied asphalt emulsion.

K. Laminating Adhesive: Recommended by metal fabricator; fully bond metal to metal, prevent telegraphing and oil canning; compatible with substrate; noncombustible after curing. VOC contents calculated according to 40 CFR 59, Subpart D (EPA Method 24) listed below.
   1. Contact Adhesive: 80 g/L or less.
   2. Metal-to-Metal Adhesive: 30 g/L or less..
   3. Multipurpose Construction Adhesive: 70 g/L or less.
   4. Special-Purpose Contact Adhesive: 250 g/L. Use for to bond melamine-covered board, metal, unsupported vinyl, ultrahigh molecular weight polyethylene, and rubber or wood veneer, 1/16 inch thick or less, to any surface.
   5. Adhesive shall comply with the testing and product requirements of CAL (CDPH SM).

L. Isolation Coating: Manufacturer's standard alkali-resistant coating.

2.04 PAINTS AND COATINGS

A. As specified in Section 09 9123.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.05 FINISHES

A. Finishes, General: Comply with NAAMM AMP 500-06.

1. Complete mechanical finishes before fabrication. After fabrication, finish joints, bends, abrasions and surface blemishes to match sheet.
2. Protect mechanical finishes on exposed surfaces from damage.
3. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
4. Appearance: Limit variations in appearance of adjacent to one-half the range represented in approved samples. Noticeable variations in the same piece are not acceptable. Install components within the range of approved samples to minimize contrast.

B. Aluminum Finishes:
1. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
2. Color: To be selected by Architect from manufacturer's custom range.
3. Touch-Up Materials: As recommended by coating manufacturer for field application.

C. Galvanized Steel Finishes:
1. Repair Galvanized Surfaces: Clean welds and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
2. Factory Prime: Apply shop primer to prepared surfaces of items where field painting after installation indicated, unless indicated otherwise. Comply with requirements in SSPC-PA 1.

D. Steel Finishes:
1. Surface Preparation: Comply with SSPC-SP 1; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust from uncoated steel; comply with SSPC-SP 5.
2. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.
3. Factory Prime: Apply shop primer to prepared surfaces of items where field painting after installation indicated, unless indicated otherwise..
4. Baked-Enamel Finish: Manufacturer's standard two-coat baked-enamel finish; topcoat minimum dry film thickness of 1.0 mil (0.025 mm). Total minimum dry film thickness: 2.0 mils (0.05 mm).
5. Powder-Coat Finish: Manufacturer's standard thermosetting polyester or acrylic urethane powder coating; minimum cured-film thickness of 1.5 mils (0.038 mm).

E. Stainless Steel Finishes:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Comply with NAAMM AMP 500-06; grind and polish surfaces to uniform finish free of cross scratches. Run grain of directional finishes with long dimension of each item.
   a. Directional Satin: No. 4.
3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

B. Coat concrete and masonry surfaces that will be in contact with metal surfaces with bituminous coating.

3.03 INSTALLATION - SHEET METAL AND PLATE FABRICATIONS

A. Locate and place decorative formed sheet metal items level and plumb; align with adjacent construction. Cut, drill and fit as required to install.

B. Do not cut or abrade sheet metal finishes that cannot be completely restored in the field. Return such items to manufacturer or fabricator for required alterations and refinishing or provide new items.

C. Use concealed anchorages where possible. Provide washers where needed on bolts or screws to protect metal surfaces and make weathertight connection.

D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers indicated.

E. Install gaskets, joint fillers, insulation, sealants, and flashings as work progresses.
   1. Make exterior decorative formed sheet metal items weatherproof.
   2. Make interior decorative formed metal items soundproof or lightproof as required.

F. Corrosion Protection: Apply permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with incompatible substrate materials. Prevent corrosion damage to material and finish.

3.04 CLEANING

A. Shop Primer Touch-up and Repair: Clean field welds, bolted connections, and abraded areas of shop paint.
   1. Paint exposed areas with same material used for shop painting.
   2. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.

B. Restore finishes damaged during installation and construction period. Return items that cannot be refinished in the field to manufacturer or fabricator. Refinish entire unit or provide new units.

C. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

D. Remove temporary coverings and protection of adjacent work areas.

E. Clean installed products in accordance with manufacturer's instructions.

3.05 PROTECTION

A. Protect installed products from damage during construction.

END OF SECTION 05 7500

SECTION 06 1000

ROUGH CARPENTRY

PART 2 PRODUCTS

1.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.
   2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

B. Lumber fabricated from old growth timber is not permitted.

1.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

1.03 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

B. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

1.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Bolt or ballistic fastener for anchorages to steel.

1.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

B. Fire Retardant Treatment:
   1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated;

capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.

a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
b. Treat rough carpentry items as indicated .
c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

END OF SECTION 06 1000

SECTION 06 2000

FINISH CARPENTRY

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.

C. Section 06 4200 - Wood Paneling: Shop fabricated custom paneling.

D. Section 08 8000 - Glazing: Glass and glazing of wood partitions and screens.

E. Section 09 9113 - Exterior Painting: Painting of finish carpentry items.

1.02 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Include certification program label.
   2. Identify all counter seaming on shop drawings.

C. Samples: Submit two samples of wood trim 6 inch (150 mm) long.

1.05 MOCK-UP

A. Construct Jersey Dsiplay Wall, Museum and Wood Slat Feature wall mock-up.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.06

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

B. Exterior Woodwork Items:
   1. Wood fencing and gate.

C. Interior Woodwork Items:

1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish as Scheduled
2. Wood Slat Feature Wall and Door.
3. Custom Jersey Display .
4. Floating Bench
5. Feature wall trim

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 SHEET MATERIALS

2.04 PLASTIC LAMINATE MATERIALS

A. Laminate Backing Sheet: NEMA LD 3, BKL; undecorated plastic laminate.

2.05 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. Fasteners: Of size and type to suit application

C. Concealed Joint Fasteners: Threaded steel.

2.06 ACCESSORIES

A. Lumber for Shimming and Blocking: Softwood lumber of douglas fir species.

B. Glass: Type GL-1 as specified in Section 08 8000.

C. Primer: Alkyd primer sealer.

D. Wood Filler: Solvent base, tinted to match surface finish color.

2.07 HARDWARE

A. Hardware: Comply with BHMA A156.9.

2.08 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. Fit exposed sheet material edges with 3/8 inch (9 mm) matching hardwood edging. Use one piece for full length only.

C. Cap exposed plastic laminate finish edges with material of same finish and pattern.

D. Shop prepare and identify components for indicated grain matching during site erection.

E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)

G. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

2.09 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. Stain: As selected by Architect.

b. Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

C. Install prefinished paneling with full bed contact adhesive applied to substrate.

D. Install hardware in accordance with manufacturer's written instructions.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.6 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

END OF SECTION 06 2000

SECTION 06 4100

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Hardware.

D. Factory finishing.

E. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 08 8000 - Glazing: Glass for casework.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Product Verification: Verify that the product specified under Part 2 matches and is identical to the product currently installed at the site.

B. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
   2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
   3. Include certification program label.

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.

4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
5. Replace, repair, or rework all work for which certification is refused.

1.07 MOCK-UP

A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.09 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Wood Veneer Faced Shelving where indicated in the drawings.
1. Exposed Surfaces: HPVA HP-1 Grade A, Maple, plain sliced, random-matched.
2. Semi-Exposed Surfaces: HPVA HP-1 Grade B, Ash, plain sliced, random-matched.
3. Concealed Surfaces: Manufacturer's option.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Hardwood Edgebanding: Use solid hardwood edgebanding matching species, color, grain, and grade for exposed portions of cabinetry.

2.03 LAMINATE MATERIALS

A. Manufacturers:
1. As indicated in Drawings.
2. Substitutions: See Section 01 6000 - Product Requirements.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as indicated.

2.04 COUNTERTOPS

A. As scheduled on Drawings.

2.05 ACCESSORIES

A. Provide custom Cascade Iron Co. steel shelf hangers as indicated in the drawings.

B. Adhesive: Type recommended by fabricator to suit application.

C. Glass: Type A as specified in Section 08 8000.

D. Fasteners: Size and type to suit application.

E. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

F. Concealed Joint Fasteners: Threaded steel.

G. Grommets: Standard Stainless Steel / Chrome Grommets, as indicated on drawings, grommets for cut-outs, in color as selected by Architect from manufacturer's standard colors.

2.06 HARDWARE

A. Manufacturer/Product:
   1. Hafele, Tab Collection, Polished Black as indicated on the drawings.
   2. Hafele, Tab Collection, Brass as indicated on the drawings.

B. Hardware: BHMA A156.9, types as referenced for quality grade specified.

C. Shelf Rests: BHMA No. B04013.

D. Drawer/Door Pulls, Basis of Design Product: Hafele, Tab Collection, as indicated in the drawings.

E. Door Locks: BHMA A156.11, E07121.

F. Drawer Locks: BHMA A156.11, E07041.

G. Drawer Slides:
   1. Static Load Capacity: Commercial grade.
      a. Box Drawer Slides: 100 lbf.
      b. File Drawer Slides: 200 lbf.
      c. Trash Bin Slides: 200 lbf.
   2. Mounting: Side mounted.
   3. BHMA No. B05091
   4. Drawer slides shall be of a self closing, stay closed type.

H. Hinges: European style concealed self-closing type, steel with polished finish.

2.07 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet (600 mm) from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
   1. Provide center matched panels at each elevation.
   2. Provide sequence matching as indicated.
   3. Carry figure of cabinet fronts to toe kicks.

F. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.08 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.

C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.

D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

1. Transparent:
    a. Stain: Match Architect's sample.
    b. Sheen: Flat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

C. Coordinate all required backing locations with appropriate trades.

3.02 INSTALLATION

A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.

E. Secure cabinets to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

A. Test installed work for rigidity and ability to support loads.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 06 4100

SECTION 06 4200
WOOD PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood plank siding.

B. Shop finishing.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Grounds and concealed blocking.

B. Section 01 1000 - Summary: Wood paneling to be removed and reinstalled.

C. Section 02 4100 - Demolition: Selective demolition for removal of wood paneling for reinstallation.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Product Verification: Verify that the product specified under Part 2 matches and is identical to the product currently installed at the site.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on fire retardant treatment materials and application instructions.

C. Inventory of Removed Material: Provide inventory of available wood panels acquired during selective demolition. Indicate on shop drawings where the removed wood panels are to be reinstalled.

D. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
   2. Provide plan of panel number sequencing.
   3. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
   4. Include certification program label.

E. Samples: Submit two samples of wood trim, 6 inch (150 mm) long.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
   2. Single Source Responsibility: Provide and install this work from single fabricator.

1.07 REGULATORY REQUIREMENTS

A. Comply with applicable code for fire retardant requirements.

1.08 MOCK-UP

A. Construct mock-up, 8 feet (2.4 m) long by 10 feet (3 m) wide, illustrating full panel sheet, edge trim, joint trim, applied finish, and grain matching.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage.

B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with recommendations of AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

PART 2 PRODUCTS

2.01 WOOD PLANK SIDING

A. Basis of Design WD-2: Nakamoto Forestry, Pika Pika SKU#NM1706 as indicated in the drawings.

2.02 PANELING

A. Quality Standard: Custom Grade, in accordance AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.03 WOOD-BASED MATERIALS - GENERAL

A. Wood fabricated from old growth timber is not permitted.

2.04 ADHESIVES AND FASTENERS

A. Adhesives: Type suitable for intended purpose, complying with applicable air quality regulations.

2.05 FABRICATION

A. Prepare panels for delivery to site, permitting passage through building openings.

B. Finish exposed edges of panels as specified by grade requirements.

2.06 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. Stain: Match Architect's sample
      b. Sheen: Satin.

E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Verify adequacy of backing and support framing.

C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Do not begin installation until wood materials have been fully acclimated to interior conditions.

C. Set and secure materials and components in place, plumb and level, using concealed fasteners wherever possible.

D. Where necessary to cut and fit on site, scribe work abutting other components. Do not use additional overlay trim to conceal gaps.

E. Coordinate the installation of firestopping behind paneling.

F. Set exposed fasteners, fill with wood filler, and finish to match panel finish.

G. Touch up damaged finish to match original, using materials provided by fabricator; replace components that cannot be refinished like new.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.6 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.8 mm).

END OF SECTION 06 4200

SECTION 06 8200

GLASS FIBER REINFORCED PLASTIC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prefinished polyester glass reinforced plastic sheets

1.02 REFERENCE STANDARDS

A. ASTM D 256 - Izod Impact Strengths (ft #/in)

B. ASTM D 570 - Water Absorption (%)

C. ASTM D 638 - Tensile Strengths (psi) & Tensile Modulus (psi)

D. ASTM D 790 - Flexural Strengths (psi) & Flexural Modulus (psi)

E. ASTM D 2583- Barcol Hardness

F. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.

G. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified component products.
   1. Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
      a. Preparation instructions and recommendations.
      b. Storage and handling requirements and recommendations.
      c. Installation methods.

C. Shop Drawings: Indicate design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colors, finishes, methods of support, integration of plumbing components, and anchorages.
   1. Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.

D. Samples: Submit two panels, 6 x 6 inch (150 x 150 mm) in size, illustrating color, texture, and finish.
   1. Submit complete with specified applied finish.
   2. For selected patterns show complete pattern repeat.
   3. Exposed Molding and Trim: Provide samples of each type, finish, and color.

E. Maintenance Data: Include instructions for stain removal, surface and gloss restoration .
   1. Manufacturers Material Safety Data Sheets (MSDS) for adhesives and sealants prior to their delivery to the site.

1.04 QUALITY ASSURANCE

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
   1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
      a. Wall Required Rating – Class A.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect components from damage by retaining shipping protection in place until installation.

B. Deliver materials factory packaged on strong pallets.

C. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (70°) for 48 hours prior to installation.

1.06 FIELD CONDITIONS

A. Do not install site fabricated components when site conditions may be detrimental to successful installation.

B. Maintain temperature and humidity conditions favorable to proper curing of resin during and after installation.
   1. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work
   2. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
      a. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fiber and Resin Fabrications:
   1. Marlite; Product as indicated in Drawings, www.marlite.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANELS

A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
   1. Coating: Multi layer print, primer and finish coats.
   2. Dimensions:
      a. Thickness – 0.090 inch (2.29mm) nominal
      b. Width - 4'-0" (1.22m) nominal
      c. Length – [10'-0" (3.0m)][8'-0" (2.4m)][As indicated on the drawings] nominal
   3. Tolerance:
      a. Length and Width: +/-1/8 inch (3.175mm)
      b. Square - Not to exceed 1/8 inch for 8 foot (2.4m) panels or 5/32 inch (3.96mm) for 10 foot (2.4m) panels

B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
   1. Flexural Strength - 1.0 x 104 psi per ASTM D 790. (7.0 kilogram-force/square millimeter)
   2. Flexural Modulus - 3.1 x 105 psi per ASTM D 790. (217.9 kilogram-force/square millimeter)
   3. Tensile Strength - 7.0 x 103 psi per ASTM D 638. (4.9 kilogram-force/square millimeter)
   4. Tensile Modulus - 1.6 x 105 psi per ASTM D 638. (112.5 kilogram-force/square millimeter)
   5. Water Absorption - 0.72% per ASTM D 570.
   6. Barcol Hardness (scratch resistance) of 35 55 as per ASTM D 2583.
   7. Izod Impact Strength of 72 ft. lbs./in ASTM D 256

C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.

D. Front Finish: As Indicated on the Drawings.

2.03 FINISH

A. Color: As indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.

B. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.

1. Verify that stud spacing does not exceed 24 inch (61cm) on-center.

C. Repair defects prior to installation.
   1. Level wall surfaces to panel manufacturer’s requirements. Remove protrusions and fill indentations.

3.02 INSTALLATION

A. Install fabrications in accordance with shop drawings and fabricator's instructions.

B. Cut sheets to meet supports allowing 1/8” inch (3 mm) clearance for every 8 foot (2.43m) of panel.
   1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
   2. Pre-drill fastener holes 1/8 inch (3.175mm) oversize with high speed drill bit.
      a. Space at 8 inches (20.32cm) maximum on center at perimeter, approximately 1 inch from panel edge.
      b. Space at in field in rows 16 inches (40.64cm) on center, with fasteners spaced at 12 inches (30.48 cm) maximum on center.

C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
   1. Install panels with manufacturer's recommended gap for panel field and corner joints.
      a. Adhesive trowel and application method to conform to adhesive manufacturer’s recommendations.
      b. Drive fasteners for snug fit. Do not over-tighten.

D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
   1. All moldings must provide for a minimum 1/8 inch (3.18mm) of panel expansion at joints and edges, to insure proper installation.
   2. Apply sealant to all moldings, channels and joints between the system and different materials to assure installation.

3.03 TOLERANCES

A. Maximum variation from true position: 1/4 inch (6 mm).

B. Maximum offset from true alignment: 1/8 inch (3 mm).

3.04 CLEANING

A. Clean components of foreign material without damaging finished surface.
   1. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.
   2. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

B. Hand rub smooth surfaces with polishing cream.

C. Clean fabrications in accordance with fabricator's instructions.

3.05 PROTECTION

A. Place protective structural covering over installed units.

END OF SECTION 06 8200

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation and integral vapor retarder at over roof sheathing.

B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 06 1000 - Rough Carpentry: Supporting construction for batt insulation.

C. Section 06 1000 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.

D. Section 07 8400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

E. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

D. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.

B. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

2.02 FOAM BOARD INSULATION MATERIALS

A. Polyisocyanurate (ISO) Board Insulation with Facers Both Sides: Rigid cellular foam, complying with ASTM C1289.
   1. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   2. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
   3. Board Edges: Square.

4. Manufacturers:
    a. GAF; EnergyGuard Polyiso Insulation: www.gaf.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
4. Formaldehyde Content: Zero.
5. Facing: Aluminum foil, flame spread 25 rated; one side.
6. Manufacturers:
    a. CertainTeed Corporation; _____: www.certainteed.com/#sle.
    b. Johns Manville; _____: www.jm.com/#sle.

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
2. Thickness: __ inch (__ mm).
3. Manufacturers:

2.04 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch (50 mm) wide.

B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

C. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION OVER STEEP SLOPE ROOF SHEATHING OR ROOF STRUCTURE

A. Installation of board insulation over steep slope roof structure or roof sheathing is specified in Section 06 1000.

3.03 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Retain insulation batts in place with spindle fasteners at 12 inches (300 mm) on center.

F. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

3.04 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 2100

SECTION 07 5419

PVC THERMOPLASTIC SINGLE-PLY ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered system with PVC thermoplastic roofing membrane.

B. Insulation, flat and tapered.

C. Flashings.

D. Roofing stack boots and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.

1.03 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.

B. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing; 2012.

C. NRCA (RM) - The NRCA Roofing Manual; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's written information listed below.
   1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.

D. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

E. Warranty:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section:
   1. Approved by membrane manufacturer.

C. Single Source Responsibility: Provide and install products from single source.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Match existing PVC roofing.

B. Acceptable Manufacturers:
   1. Sarnafil
   2. Johns Manville
   3. Carlisle SynTec: www.carlisle-syntec.com/#sle.

2.02 ROOFING APPLICATIONS

A. PVC Membrane Roofing: One ply membrane, mechanically fastened, over insulation.

B. Roofing Assembly Performance Requirements and Design Criteria:

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:
   1. Material: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M.
   2. Product:

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: As recommended and approved by membrane manufacturer.

D. Flexible Flashing Material: Same material as membrane.

2.04 INSULATION

A. Composite Polyisocyanurate (ISO) Board Insulation: ASTM C1289, Type II, Class 2 - Faced with coated polymer-bonded glass fiber mat facers on both major surfaces of the core foam, laminated to high density polyisocyanurate cover board.
   1. Core Foam Grade and Compressive Strength: Grade 2, 20 psi (Grade 2, 138 kPa), minimum.
   2. Cover Board Type, Class, Grade and Compressive Strength: Type II, Class 4, Grade 1, 80 psi (Grade 1, 551 kPa), minimum.

2.05 ACCESSORIES

A. Prefabricated Flashing Accessories:
   1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
   2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
   3. Walkway Rolls: Sure-Flex Heat Weldable Walkway Rolls; 80 mils (0.080 inch) (2 mm) thick; gray membrane.
   4. Miscellaneous Flashing: Non-reinforced PVC membrane; 80 mils (0.080 inch) (2 mm) thick, in manufacturer's standard lengths and widths.

B. Membrane Adhesive: As recommended by membrane manufacturer.

C. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

D. Sealants: As recommended by membrane manufacturer.

E. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.

F. Edgings and Terminations: Manufacturer's standard edge and termination accessories.
   1. Snap-On Edge System:
   2. Anchor Bar Fascia System:
   3. Drip Edge: Carlisle Sure-Seal Drip Edge.
   4. Coping:
   5. PVC Coated Sheet Metal.
   6. Termination Bar.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION, GENERAL

A. Clean substrate thoroughly prior to roof application.

3.03 WOOD DECK PREPARATION

A. Verify flatness and tightness of joints of wood decking. Verify that all wood decking edges are fully supported. Fill knot holes with latex filler or completely cover with securely nailed sheet metal.

B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

3.04 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.05 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.06 INSULATION

A. Lay subsequent layers of insulation with joints staggered minimum 6 inch (150 mm) from joints of preceding layer.

B. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch (6.3 mm). Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

C. Do not apply more insulation than can be completely waterproofed in the same day.

3.07 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Seam Welding:
   1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches (51 mm).
   2. Cover all seams with manufacturer's recommended joint covers.
   3. Probe all seams once welds have thoroughly cooled. (Approximately 30 minutes.)
   4. Repair all deficient seams within the same day.
   5. Seal cut edges of reinforced membrane after seam probe is complete.

D. Mechanical Attachment:
   1. Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches (100 mm) onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. Coordinate installation of roof drains and sumps and related flashings.

G. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.08 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.

B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

END OF SECTION 07 5419

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, sheet metal roofing, and other items indicated in Schedule.

B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.

B. Section 06 1000 - Rough Carpentry: Wood blocking for batten seams.

C. Section 07 6100 - Sheet Metal Roofing.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

F. CDA A4050 - Copper in Architecture - Handbook; current edition.

G. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Maintain one copy of each document on site.

C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with ____ years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239 inch) (0.61 mm) thick base metal.

B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.

1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
2. Color: As selected by Architect from manufacturer's standard colors.

C. Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) (0.81 mm) thick; anodized finish of color as selected.
1. Clear Anodized Finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils (0.018 mm) thick.
2. Color Anodized Finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mils (0.018 mm) thick.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

3.03 INSTALLATION

A. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.05 SCHEDULE

A. Counterflashings at Roofing Terminations (over roofing base flashings):

B. Counterflashings at Curb-Mounted Roof Items, including skylights and roof hatches:

C. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports:

END OF SECTION 07 6200

SECTION 07 7100
ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including gravel stops.

1.02 RELATED REQUIREMENTS

A. Section 07 7200 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.

C. NRCA (RM) - The NRCA Roofing Manual; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roof Edge Flashings and Copings:
   1. Architectural Products Co; _____: www.archprod.com/#sle.
   2. ATAS International, Inc; Rapid-Lok Fascia: www.atas.com/#sle.
   3. Metal-Era Inc; _____: www.metalera.com/#sle.
   4. OMG Roofing Products; _____: www.omgroofing.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Fascia, cant, and edge securement for roof membrane.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.

2.03 FINISHES

A. Clear Anodized Finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils (0.018 mm) thick.

2.04 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Seal joints within components when required by component manufacturer.

C. Anchor components securely.

D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION 07 7100

SECTION 07 7200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping support curbs.

B. Equipment rails.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

D. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 ROOF CURBS

A. Manufacturers:
   1. AES Industries Inc; _____: www.aescurb.com/#sle.
   2. The Pate Company; _____: www.patecurbs.com/#sle.
   3. LMCurbs; Roof Curbs: www.lmcurbs.com/#sle.
   4. Roof Products & Systems (RPS); _____: www.rpscurbs.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
   1. Roof Curb Mounting Substrate: Curb substrate consists of standing seam metal roof panel system.
   2. Sheet Metal Material:
      a. Aluminum: 0.080 inch (2.03 mm) minimum thickness, with 3003 alloy, and H14 temper.
   3. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches (102 mm).
   4. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.

a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch (152 mm) clearance between curb and metal roof panel flange allowing water to properly flow past curb.
b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.
c. Maintain at least 12 inch (305 mm) clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
d. Lap lower curb flange overtop of down sloping metal roof panel and seal connection.

5. Provide layouts and configurations indicated on drawings.

C. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
1. Provide preservative treated wood nailers along top of curb.
2. Insulate inside curbs with 1-1/2 inch (38 mm) thick fiberglass insulation.

D. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.

E. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches (400 mm) square unless otherwise indicated.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

END OF SECTION 07 7200

SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Cutting and patching.

B. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ITS (DIR) - Directory of Listed Products; current edition.

B. FM 4991 - Approval Standard for Firestop Contractors; 2013.

C. FM (AG) - FM Approval Guide; current edition.

D. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Certificate from authority having jurisdiction indicating approval of materials used.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
   2. Verification of minimum three years documented experience installing work of this type.
   3. Verification of at least five satisfactorily completed projects of comparable size and type.
   4. Licensed by local authorities having jurisdiction (AHJ).

1.06 MOCK-UP

A. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
   2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft (1/3 linear m).

B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.

C. If accepted, mock-up will represent minimum standard for the Work.

D. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products; www.3m.com/firestop.
   2. Hilti, Inc; www.us.hilti.com/#sle.
   3. Specified Technologies Inc; www.stifirestop.com/#sle
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRESTOPPING SYSTEMS

A. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches (100 mm) or less: Caulk or putty.
   1. Floors: ULUL Design No. F-A-1001-1999, F Rating 2 hour.
      a. F Rating 3 hour at first floor.
   2. Other Interior PartitionsFire Barriers: ULUL Design No. W-L-1001-1999, F Rating 3/41 hour.

B. Firestopping at Combustible Pipe and Conduit Penetrations, of diameter 4 inches (100 mm) or less: Any material meeting requirements.
   1. Floors: ULUL Design No. F-A-2001-2999, F Rating 2 hour.
   2. Other Interior PartitionsFire Barriers: ULUL Design No. W-L-2001-2999, F Rating 3/41 hour.

C. Firestopping at Cable Tray Penetrations: Any material meeting requirements.
   1. Floors: ULUL Design No. F-A-4001-4999, F Rating 2 hour.
   2. Other Interior PartitionsFire Barriers: ULUL Design No. W-L-4001-4999, F Rating 3/41 hour.

D. Firestopping at Cable Penetrations, not in Conduit or Cable Tray: Caulk or putty.
   1. Floors: ULUL Design No. F-A-3001-3999, F Rating 2 hour.
   2. Other Interior PartitionsFire Barriers: ULUL Design No. W-L-3001-3999, F Rating 3/41 hour.

E. Firestopping at Control and Expansion Joints (without Penetrations): Any material meeting requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

C. Install labeling required by code.

3.04 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 8400

SECTION 07 9005
JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants and joint backing.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping: Firestopping sealants.

B. Section 08 8000 - Glazing: Glazing sealants and accessories.

C. Section 09 2116 - Gypsum Board Assemblies: Acoustic sealant.

D. Section 09 3000 - Tiling: Sealant used as tile grout.

1.03 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2014.

B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

C. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

1.06 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

1.07 MOCK-UP

A. Provide mock-up of sealant joints in conjunction with window and wall under provisions of Section 01 4000.

B. Construct mock-up with specified sealant types and with other components noted.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Silicone Sealants:
   1. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.

B. Polyurethane Sealants:
   1. Pecora Corporation: www.pecora.com.

C. Acrylic Sealants (ASTM C920):
   1. Tremco Global Sealants: www.tremcosealants.com.

D. Butyl Sealants:
   1. Pecora Corporation: www.pecora.com.

E. Acrylic Emulsion Latex Sealants:
   1. Pecora Corporation: www.pecora.com.

2.02 SEALANTS

A. Type E-1 - General Purpose Exterior Sealant: Low Modulus Silicone; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single component.
   1. Color: Standard colors matching finished surfaces..
   2. Product: Silpruf, Silglaz or GESIL manufactured by GE Sealants.
   3. Applications: Use for:
      a. Control, expansion, and soft joints in masonry.
      b. Joints between concrete and other materials.
      c. Joints between metal frames and other materials.
      d. Other exterior joints for which no other sealant is indicated.

B. Type E-2 - Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
   1. Applications: Use for:
      a. Concealed sealant bead in sheet metal work.
      b. Concealed sealant bead in siding overlaps.

C. Type I-1 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
   1. Color: Standard colors matching finished surfaces..
   2. Product: AC-20 manufactured by Pecora Corporation.
   3. Applications: Use for:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and wall surfaces.
      c. Other interior joints for which no other type of sealant is indicated.

D. Type I-2 - Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
   1. Product: 1702 Sanitary Sealant manufactured by GE Plastics.
   2. Applications: Use for:
      a. Joints between plumbing fixtures and floor and wall surfaces.
      b. Joints between kitchen and bath countertops and wall surfaces.

E. Type A-1 - Acoustical Sealant for Concealed Locations: Permanently tacky non-hardening butyl sealant.
   1. Applications: Use for concealed locations only:
      a. Sealant bead between top stud runner and structure and between bottom stud track and floor.

F. Type I-3 - Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C920, Grade P, Class 25, Uses T, M and A; single component.
   1. Approved by manufacturer for wide joints up to 1-1/2 inches.
   2. Color: Standard colors matching finished surfaces..

3. Product: Urexpan NR-200 manufactured by Pecora Corporation.
4. Applications: Use for:
    a. Expansion joints in floors.

G. Type E-3 - Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.
1. Color: Gray.
2. Product: Urexpan NR-200 manufactured by Pecora Corporation.
3. Applications: Use for:
    a. Joints in sidewalks and vehicular paving.

H. Type I-4 - Silicone Sealant: ASTM C920, Grade NS, Class 25, Uses NT, A, G, M, O; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.
1. Color: Standard colors matching finished surfaces.
2. Product: IS800 Series or 786 manufactured by GE Sealants or Dow Corning.
3. Applications: Use for:

2.03 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

E. Install bond breaker where joint backing is not used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

H. Tool joints concave.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION

A. Protect sealants until cured.

3.06 SCHEDULE

A. Exterior Joints for Which No Other Sealant Type is Indicated: Type E-1 colors as selected.

B. Control and Expansion Joints in Paving: Type E-3.

C. Lap Joints in Exterior Sheet Metal Work: Type E-2.

D. Interior Joints for Which No Other Sealant is Indicated: Type I-1; colors as shown on the drawings.

E. Control and Expansion Joints in Interior Concrete Slabs and Floors: Type I-3.

F. In STC-Rated Walls, Between Metal Stud Track/Runner and Adjacent Construction and Between Outlet Boxes and Gypsum Board: Type A-1.

END OF SECTION 07 9005

SECTION 08 1113

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames.

D. Sound-rated hollow metal doors and frames.

E. Hollow metal borrowed lites glazing frames.

F. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

C. Section 09 9113 - Exterior Painting: Field painting.

D. Section 01 1000 - Summary: Doors to be removed and reinstalled.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.

H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

I. ITS (DIR) - Directory of Listed Products; current edition.

J. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.

K. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

L. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.

M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

N. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.

O. UL (DIR) - Online Certifications Directory; Current Edition.

P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

Q. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Product Verification: Verify that the product specified under Part 2 matches and is identical to the product currently installed at the site.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.02 HOLLOW METAL DOORS

A. Interior Doors, Non-Fire Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20 gage, 0.032 inch (0.8 mm), minimum.
   2. Grade: ANSI A250.8 Level 4, physical performance Level A, Model 2, seamless, for doors over 36".
   3. Door Thickness: 1-3/4 inch (44.5 mm), nominal.

B. Fire-Rated Doors:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20 gage, 0.032 inch (0.8 mm), minimum.
   2. Grade: ANSI A250.8 Level 4, physical performance Level A, Model 2, seamless, for doors over 36".
   3. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
      a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      b. Attach fire rating label to each fire rated unit.
      c. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;

1) Maximum Air Leakage: 3.0 cfm/sq ft (0.02 cu m/sec/sq m) of door opening at 0.10 inch w.g. (24.9 Pa) pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
2) Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
3) Label: Include the "S" label on fire-rating label of door.

4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
5. Door Thickness: 1-3/4 inch (44.5 mm), nominal.

C. Sound-Rated Interior Doors: Eggers SG4 - STC 53
1. Provide Security Acoustics Series F53C at all sound studio doors.
2. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 1 - Standard-duty.
b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 20 gage, 0.032 inch (0.8 mm), minimum.
3. Door Thickness: As required to meet acoustic requirements indicated.
4. Opening Force of Sound-Rated Doors, Non-Fire Rated: 5 lbs (22.2 N), maximum, in compliance with ADA Standards.

2.03 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.

C. Door Frames, Fire-Rated: Knock-down type.
1. Fire Rating: Same as door, labeled.

D. Sound-Rated Door Frames: Knock-down type.

E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

F. Mullions for Pairs of Doors: Fixed, with profile similar to jambs.

G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

H. Transom Bars: Fixed, of profile same as jamb and head.

2.04 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.05 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.

B. Glazing: As specified in Section 08 8000, factory installed.

C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

D. Astragals for Double Doors: Specified in Section 08 7100.

E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

G. Provide at all IDF and Electrical Rooms

1. Attach the equivalent of Pemko Type 773 frame seals to the door head and jambs.
2. Attach the equivalent of a Pemko Type 234V door shoe to the bottom of the door. Undercut the door by no more than 3/8" so that the shoe's fins will compress against the threshold when the door is closed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 08 7100.

E. Comply with glazing installation requirements of Section 08 8000.

F. Coordinate installation of electrical connections to electrical hardware items.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 1113

SECTION 08 1116

ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Hardware for aluminum doors.

B. Section 08 8000 - Glazing: Glazing materials for aluminum doors and frames.

C. Section 09 9113 - Exterior Painting: Field finishing.

1.03 REFERENCE STANDARDS

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Product Verification: Verify that the product specified under Part 2 matches and is identical to the product currently installed at the site.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for each type of door; include information on fabrication methods.

C. Inventory of Removed Material: Provide inventory of available doors and frames acquired during selective demolition. Indicate on shop drawings where the removed doors and frames are to be reinstalled.

D. Shop Drawings: Include elevations of each opening type.
   1. Verify dimensions by field measurements before fabrication and indicate on shop drawings.

E. Verification Samples: Actual pieces of products in each finish specified, not less than 6 inches (150 mm) square or 6 inches (150 mm) long for linear components. For finishes subject to color variation, include not less than two samples illustrating extreme range to be anticipated.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum components in manufacturer's standard protective packaging, palleted, crated, or banded together.

B. Inspect delivered components for damage and replace. Repaired components will not be accepted.

C. Store components in clean, dry, indoor area, under cover in manufacturer's packaging until installation.

D. Protect materials and finish from damage during handling and installation.

1.08 FIELD CONDITIONS

A. Do not begin installation of interior aluminum components until space has been enclosed and ambient thermal conditions are being maintained at levels consistent with final project requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 FINISHES

A. Frames shall be Black Anodized Aluminum

B. Class I Color Anodized Finish: Electrolytically deposited colored anodic coating; AAMA 611 AA-M12C22A44, minimum dry film thickness 0.7 mils (0.018 mm).

2.03 ACCESSORIES

A. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.

B. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.

3.02 PREPARATION

A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.

B. Replace components with damage to exposed finishes.

C. Separate dissimilar metals to prevent electrolytic action between metals.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and approved shop drawings.

B. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.

C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.

D. Hang doors and adjust hardware to achieve specified clearances and proper door operation.

E. Install door hardware as specified in Section 08 7100.

F. Install glazing; set glazing stops and glazing gaskets flush with face of door or frame.

3.04 CLEANING

A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609 & 610.

B. Do not use abrasive, caustic, or acid cleaning agents.

3.05 PROTECTION

A. Protect products of this section from damage caused by subsequent construction until Date of Substantial Completion.

B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION 08 1116

SECTION 08 1416
FLUSH WOOD DOORS

PART 2 PRODUCTS

1.01 DOORS

A. Doors: Refer to drawings for locations and additional requirements.

1.02 DOOR AND PANEL CORES

1.03 DOOR FACINGS

A. Facing Adhesive: Type I - waterproof.

1.04 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

C. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

D. Provide edge clearances in accordance with the quality standard specified.

1.05 FACTORY FINISHING - WOOD VENEER DOORS

A. Factory finish doors in accordance with sample to be provided.

B. Seal door top edge with color sealer to match door facing.

END OF SECTION 08 1416

SECTION 08 3100

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall access door and frame units.

B. Ceiling access door and frame units.

1.02 RELATED REQUIREMENTS

A. Section 092116: Openings in partitions.

B. Section 092116: Openings in ceilings.

C. Section 09 9113 - Exterior Painting: Field paint finish.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
   1. Manufacturer’s data sheets on each product to be used, including dimensions, finishes, storage and handling requirements and recommendations, and installation recommendations.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
   1. Provide drawings showing dimensions and joint details.
   2. Access panels in lobbies and feature areas with gypsum ceilings are prohibited

D. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.

E. Project Record Documents: Record actual locations of each access unit.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS

A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.

B. Units in Fire Rated Assemblies: Fire rating equivalent to the fire rated assembly in which they are to be installed.
   1. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.
   1. If substrate preparation is responsibility of another installer, notify architect of unsatisfactory conditions before proceeding.

3.02 PREPARATION

A. Clean surface thoroughly prior to installation.

B. Prepare surfaces using methods recommended by the manufacturer for achieving the best result for the substrate under project conditions.

C. Install supplementary and permanent supports as required for proper installation.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install in accordance with applicable code, plumb and true to line, shim where necessary.

C. Coordinate work with related gypsum wallboard work and framing.

D. Install frames plumb and level in openings, and secure units rigidly in place.

E. Position units to provide convenient access to concealed equipment when necessary.

F. Finish joints as specified for adjacent gypsum board work in Section 09 2116.
   1. Finish joints and surfaces as required for Level 5 in ASTM C 840.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION 08 3100

SECTION 08 3473

SOUND CONTROL DOORS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes all labor, material, accessories and equipment necessary to provide sound control doors (including door, gaskets, hardware and door frame) where shown on the drawings and as specified below.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 08 10 00 - Metal Doors and Frames.

B. Section 08 71 00 - Door Hardware.

C. Section 09 91 00 - Painting.

1.03 REFERENCES

A. ASTM E90 - Standard Test Method for laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

B. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Insulation in Buildings.

C. ASTM E413 - Classification for Rating Sound Insulation.

1.04 SUBMITTALS

A. Compliance: Comply with pertinent provisions of Division 1 - General Requirements.

B. Specifications: Submit Manufacturer’s specifications and other data needed to prove compliance with all specified requirements.

C. Installation Instructions: Submit Manufacturer’s recommended installation instructions and procedures.

D. Shop Drawings: Submit large scale shop drawings showing elevation of all sound control doors and frames, jamb and head details, hardware reinforcing details of doors and frames, door and frame location schedule, complete door and frame descriptive nomenclature, material description and gauges, astragal and meeting stile details, methods of anchorage, hardware preparation locations and gaskets, cam lift hinges and door manufacturer’s other proprietary hardware.

E. Acoustical Laboratory Test Reports: Submit Manufacturer’s octave band sound transmission loss values from 125 hertz to 4,000 hertz and STC values for each of the specified doors. Sound transmission loss and STC values shall be based on measurements conducted by a laboratory accredited for specific acoustical testing under the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E 90.

F. Certification: Manufacturer shall certify that the sound control doors (including doors, door frames, hardware and all head, jamb, astragal gaskets, etc) meet or exceed the specified laboratory octave band transmission loss and STC values listed below when tested in accordance with ASTM E90.

1.05 ACOUSTICAL PERFORMANCE REQUIREMENTS

A. Provide sound control doors that comply with the minimum octave band sound transmission loss and Sound Transmission Class (STC) values specified below for doors scheduled on the drawings. Sound transmission loss and STC values shall be based on laboratory acoustical testing, which is performed by a National Voluntary Laboratory Accreditation Program (NVLAP) approved testing laboratory. Testing shall be performed in accordance with ATSM E90.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The Manufacturer shall have successful experience in the fabrication and installation of sound control doors, including no less than 5 years' experience in the fabrication and installation of doors equal to the size and complexity of this work. Upon request, the manufacturer shall provide references and acoustical test reports for three similar recently completed projects.

B. Installer qualifications: Sound control door and frame assemblies must be installed by manufacturer, manufacturer's authorized distributor or an installer qualified in the installation and maintenance of specified equipment as approved by manufacturer.

C. Single Source Responsibility: A single firm shall be responsible for the design, fabrication and installation of the sound control doors (including all accessories and hardware).

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Division 1 - General Requirements.

B. Protect products during transit, storage and handling to prevent damage, soiling and deterioration. Comply with the requirements of the manufacturer's instructions for storage and handling.

C. Store doors upright, in a protected dry area, at least 1-inch or more off of the ground or floor and provide at least 1/4-inch space between individual doors.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Industrial Acoustics Company, Bronx, NY, (718) 931-8000.

B. Jamison Door Company, Hagerstown, MD, (800) 532-3667.

C. Krieger Steel Products Company, Pico Rivera, CA, (562) 695-0645.

D. Overly Manufacturing Company, Greensburg, PA, (724) 834-7300.

E. Noise Barriers, LLC, Libertyville, IL, (847) 843-0500.

2.02 MATERIALS

A. Type SCD-2: Sound Control Door:
   1. Minimum leaf thickness: 1-3/4-inches.
   2. Minimum leaf weight: 10.0 psf.
   3. Operation: Manual.
   4. Opening Sizes: As scheduled on drawings.
   5. Threshold gaskets: Adjustable type, using compression gaskets of door manufacturer's proprietary design.
   6. Jamb and head gaskets: Adjustable type, using compression gaskets of door manufacturer's proprietary design.
   7. Meeting stile gaskets: Adjustable type, using compression gaskets of door manufacturer's proprietary design.
   8. Hinges: Cam-lift. Non cam-lift hinges are not acceptable.
   9. Threshold: Hard, solid flat surface, such as concrete or a flat steel plate caulked and fastened to floor.
   10. Door frames: Heavy gauge steel frames sealed to adjacent walls. Hollow cavities of frames (head and jamb) shall be fully grouted. Edges of frames shall be caulked or grouted to walls.
   11. Laboratory Sound Transmission Loss Performance (STC-50 Min.):

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install sound control doors in accordance with manufacturer's recommendations, instructions and under manufacturer's supervision. The door Manufacturer shall work closely

with the Contractor and shall have ultimate responsibility for the installations. Manufacturer shall coordinate field installations by providing detailed advice and field supervision.

B. Installer shall examine door openings to verify that openings comply with the indicated requirements for type, size, location and acoustic characteristics. Installer shall also verify that openings are free of defects that could cause the doors to fail the sound isolation performance requirements. Installer shall not proceed with installation until all unsatisfactory conditions have been corrected.

C. Do not install doors or frames that are observed to be warped, bowed, deformed or otherwise damaged or defaced to such an extent as to impair strength, appearance and sound isolation properties. Remove and replace components that have been damaged in the process of installation.

D. Door Frames:
   1. Set frames accurately in location, in perfect alignment, plumb, straight and true. Brace frames to prevent displacement. Coordinate installation of built-in anchors for wall and partition construction as required with other work.
   2. During installation, fill door frames solid with poured grout.

E. Doors:
   1. Apply hardware in accordance with hardware manufacturer's templates and instructions.
   2. Align and adjust all door components (door frames, panels, gaskets, hardware, etc.) in accordance with Manufacturer's instructions

3.02 FIELD ACOUSTICAL VERIFICATION TESTS

A. At the Contractor's expense, sound control doors shall be tested for field acoustical performance within 60 days after the completion of installation in accordance with ASTM E336. Acoustical performance shall be determined and evaluated by the measurement of Noise Reduction (NR) and the calculation of the resulting Noise Isolation Class (NIC) of all doors. The Contractor and the manufacturer or his representative shall be on hand to observe the field-testing, correct problems, and make final adjustments as required.

B. The doors shall be tested after the doors have been installed to the satisfaction of the manufacturer or his designated representative.

C. Field acoustical performance measurements shall be conducted on site by an independent acoustical consultant with a minimum of 5-years' experience in sound isolation measurements.

D. Noise reduction tests shall be made in general conformance with a recent edition of ASTM E 336 with receiving room sound measurements made at no greater than 6-ft from the doors. NIC ratings shall be calculated in accordance with a recent edition of ASTM E 413.

E. Sound control doors shall achieve the NIC ratings as specified. If doors fail to achieve specified NIC ratings by more than 3 STC points, they shall be adjusted, corrected, or replaced and retested until they meet the specified requirements. All such work shall be at no cost to the Owner.

3.03 ADJUSTING

A. Upon completion of work and before final inspection, adjust all gaskets to provide airtight seals with no visible gaps or spaces around all sound control doors. No light leaks shall be visible at the gasket seals. Once properly adjusted, the door gaskets shall provide a firm uniform compression seal around the perimeters of the doors.

B. Once fully adjusted all sound control doors and associated hardware shall operate smoothly and properly. Adjust or replace doors that do not operate freely or are damaged.

3.04 CLEANING

A. Clean all door surfaces, seals, jambs and thresholds after installation. Exercise care to avoid damage to protective coatings and finishes. Remove excess sealant, grout, dirt and other substances. Lubricate hardware and other moving parts.

3.05 PROTECTION

A. Protection of sound control doors from damage shall be provided in accordance with manufacturer's recommendations such that doors will be undamaged at project completion. Protection from damage by other trades after installation of doors shall be provided by the General Contractor. Gaskets deformed as a result of door shoes or other devices used to hold the sound control doors open shall be replaced at no cost to the owner.

END OF SECTION 08 3473

SECTION 08 3613

ROLL-UP GLASS SECTIONAL DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overhead sectional door electrically operated.

B. Operating hardware and supports.

C. Electrical controls.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Steel channel opening frame.

B. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

C. Section 08 7100 - Door Hardware: Lock cylinders.

D. Section 09 9113 - Exterior Painting: Finish painting.

E. Section 26 0583 - Wiring Connections.

1.03 REFERENCE STANDARDS

A. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

B. DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors; 2011.

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.

D. NEMA MG 1 - Motors and Generators; 2014.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

C. Product Data: Show component construction, anchorage method, and hardware.

D. Samples: Submit two panel finish samples, ___ by ___ inch (___ by ___ mm) in size, illustrating color and finish.

E. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.

F. Operation Data: Include normal operation, troubleshooting, and adjusting.

G. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years documented experience.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Overhead Door, Model 521 Aluminum Full - View Doors with electric operator

B. Other Acceptable Manufacturers - Sectional Doors:
   1. C.H.I. Overhead Doors; Model 3295 Aluminum Full-View Doors: www.chiohd.com/#sle.
   2. Clopay Building Products; Model 3720: www.clopaydoor.com/#sle.
   3. Entrematic; Amarr 3552 Aluminum Full View Door: www.amarr.com/commercial/#sle.
   4. Wayne-Dalton, a Division of Overhead Door Corporation; Product ____: www.wayne-dalton.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ALUMINUM DOORS

A. Aluminum Doors: Flush aluminum, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
   1. Door Nominal Thickness: 2 inches (50 mm) thick.
   2. Thermal Resistance: R-value (RSI-value) of 3.22 (0.57), minimum, for overall thickness indicated.
   3. Air Leakage Rate: Less than 0.40 cfm/sf (2.0 L/sec/sq m) when tested in accordance with ASTM E283 at test pressure difference of 1.57 psf (75 Pa).
   4. Finish: Factory finished with acrylic baked enamel; _____ color.
   5. Glazed Lights: Unless indicated otherwise in the drawings, provide Three glazed lights per panel, one row; set in place with resilient glazing channel.

B. Door Panels: Flush aluminum construction; outer aluminum sheet ___ inch (____ mm) thick; inner aluminum sheet ____ inch (____ mm) thick; flat profile; core reinforcement of ____ inch (____ mm) roll formed aluminum; rabbeted weather joints at meeting rails; insulated.

C. Glazing: Annealed float glass; single pane; clear; 1/8 inch (3.2 mm) thick.

2.03 COMPONENTS

A. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.

B. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.

C. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.

D. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.

E. Head Weatherstripping: EPDM rubber seal, one piece full length.

F. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

G. Lock: Inside center mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle.

2.04 ELECTRIC OPERATION

A. Electric Operators:
   1. Mounting: Side mounted on cross head shaft.
   2. Motor Enclosure:

3. Motor Rating: 1/3 hp (250 W); continuous duty.
4. Motor Voltage: 120 volts, single phase, 60 Hz.
5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
6. Controller Enclosure: NEMA 250, Type 1.
7. Opening Speed: 12 inches per second (300 mm/s).
8. Brake: Adjustable friction clutch type, activated by motor controller.
9. Manual override in case of power failure.
10. Refer to Section 26 0583 for electrical connections.

B. Motor: NEMA MG 1, Type 1.

C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box sized to comply with NFPA 70.

D. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
1. 24 volt circuit.
2. Surface mounted, at interior door jamb.
3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.

E. Disconnect Switch: Factory mount disconnect switch in control panel.

F. Electric Operator: Side mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.

G. Safety Edge: Located at bottom of sectional door panel, full width; electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object; hollow neoprene covered to provide weatherstrip seal.

H. Control Station: Standard three button (open-close-stop) momentary type control for each electric operator.
1. 24 volt circuit.
2. Surface mounted.
3. Locate at inside door jamb.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

B. Apply primer to wood frame.

3.03 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction and building framing without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including hardware.

E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.04 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch (1.5 mm).

B. Maximum Variation from Level: 1/16 inch (1.5 mm).

C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10 ft (3 m) straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.05 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.06 CLEANING

A. Clean doors and frames and glazing.

B. Remove temporary labels and visible markings.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION 08 3613

SECTION 08 4313

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Steel attachment members.

B. Section 08 8000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

E. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least eight years of documented experience.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

2.02 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Black Anodized (Class II color anodized.)
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   2. Finish Color: Black.
   3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
   7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Glazing Stops: Flush.
   3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

C. Fasteners: Stainless steel.

D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

E. Glazing Accessories: As specified in Section 08 8000.

F. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

END OF SECTION 08 4313

SECTION 08 6200
UNIT SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermoformed plastic skylights with integral frame.

B. Operating mechanism.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood framing for rough opening.

B. Section 06 1000 - Rough Carpentry: Wood support curbs.

1.03 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2011.

B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

I. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2007 (Reapproved 2016).

J. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide structural, thermal, and daylighting performance values.

C. Shop Drawings: Indicate configurations, dimensions, locations, fastening methods, and installation details.

D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
   1. Evidence of AAMA Certification.
   2. Evidence of WDMA Certification.
   3. Evidence of CSA Certification.
   4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

E. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than eight years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty, including coverage for leakage due to defective skylight materials or construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Unit Skylights:
   1. Basis of Design: Kingspan Light + Air; Formerly Bristolite Daylighting Systems, Inc; Bristol: www.bristolite.com/#sle. Model shall be Kisngspan Quasar Prismatic Model 4848-ALT
   2. Alternates: Other manufacturers which might be capable of providing comparable product include the following listed below. It is the responsibility of any supplier providing product for the project to demonstrate that the proposed item meets the requirements of the specifications including equivalent performance characteristics to the 'Basis of Design'. If an 'Alternate' manufacturer is utilized, submit product documentation pursuant to the Div. 1 requirements for 'Substitutions' as describe in Section 012500.
      a. PHP Systems/Design; _____: www.vtechskylights.com/#sle.
      b. Sunoptics Prismatic Skylights, a Division of Acuity Brands; Signature Series Skylights - SIG: www.sunoptics.com/#sle.
      c. Velux America, Inc; VELUX Dynamic Dome: www.veluxusa.com/#sle.
      d. Wasco Skylights - Part of the VELUX Group; ____: www.wascoskylights.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 UNIT SKYLIGHTS

A. Unit Skylights: Factory-assembled glazing in aluminum frame, free of visual distortion, and weathertight.
   1. Glazing: Single.
   2. Operation: Operable for ventilation.

2.03 PERFORMANCE REQUIREMENTS

A. Provide unit skylights that comply with the following:
   1. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific skylight type:
   2. Allow for expansion and contraction within system components caused by a cycling surface temperature range of 170 degrees F (95 degrees C) without causing detrimental effects to system or components.

2.04 COMPONENTS

A. Double Glazing: Acrylic plastic; factory sealed.
   1. Outer Glazing: Clear transparent.
   2. Inner Glazing: White translucent.
   3. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.88, nominal.
   4. Visible Light Transmittance (VLT): 0.70 percent , minimum. (Code Min: 0.64)
   5. Solar Heat Gain Coefficient (SHGC): 0.47 percent, nominal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that openings and substrate conditions are ready to receive work of this section.

3.02 PREPARATION

A. Apply protective back coating on aluminum surfaces of skylight units that will be in contact with cementitious materials or dissimilar metals.

3.03 INSTALLATION

A. Install unit skylights in accordance with manufacturer's instructions and ASTM E2112.

B. Install skylight units and mount securely to curb assembly; install counterflashing as required.

C. Apply sealant to achieve watertight assembly.

3.04 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down exposed surfaces; wipe surfaces clean.

C. Remove excess sealant.

END OF SECTION 08 6200

SECTION 08 7100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood, aluminum, hollow metal, and glass doors.

B. Hardware for fire-rated doors.

C. Electrically operated and controlled hardware.

D. Thresholds.

E. Weatherstripping and gasketing.

F. Gate locks.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.

B. Section 08 1116 - Aluminum Doors and Frames.

C. Section 08 1416 - Flush Wood Doors.

D. Section 28 1000 - Access Control: Electronic access control devices.

1.03 PRICE AND PAYMENT PROCEDURES

A. Allowances: See Section 01 2100 - Allowances, for cash allowances affecting this section.

1.04 REFERENCE STANDARDS

A. BHMA A156.1 - American National Standard for Butts and Hinges; 2013.

B. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2011.

C. BHMA A156.3 - American National Standard for Exit Devices; 2014.

D. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.

E. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.

F. BHMA A156.6 - American National Standard for Architectural Door Trim; 2010.

G. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2016.

H. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2010.

I. BHMA A156.12 - American National Standard for Interconnected Locks; 2013.

J. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2012.

K. BHMA A156.14 - American National Standard for Sliding and Folding Door Hardware; 2013.

L. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2011.

M. BHMA A156.16 - American National Standard for Auxiliary Hardware; 2013.

N. BHMA A156.17 - American National Standard for Self Closing Hinges & Pivots; 2014.

O. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.

P. BHMA A156.21 - American National Standard for Thresholds; 2014.

Q. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012.

R. BHMA A156.23 - American National Standard for Electromagnetic Locks; 2010.

S. BHMA A156.25 - American National Standard for Electrified Locking Devices; 2013.

T. BHMA A156.26 - American National Standard for Continuous Hinges; 2012.

U. BHMA A156.30 - American National Standard for High Security Cylinders; 2014.

V. BHMA A156.31 - American National Standard for Electric Strikes and Frame Mounted Actuators; 2013.

W. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.

X. ITS (DIR) - Directory of Listed Products; current edition.

Y. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Z. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

AA. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

AB. UL (DIR) - Online Certifications Directory; Current Edition.

AC. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
   1. Architect.
   2. Installer's Architectural Hardware Consultant (AHC).
   3. Hardware Installer.
   4. Owner's Security Consultant.

D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

E. Keying Requirements Meeting:
   1. Schedule meeting at project site prior to Contractor occupancy.
   2. Attendance Required:
      a. Contractor.
      b. Owner.
      c. Architect.
      d. Installer's Architectural Hardware Consultant (AHC).
      e. Owner's Security Consultant.
   3. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
      c. Verify that keying and programming complies with project requirements.
      d. Establish keying submittal schedule and update requirements.
   4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
      a. Access control requirements.
      b. Key control system requirements.
      c. Schematic diagram of preliminary key system.
   5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
   6. Deliver established keying requirements to manufacturers.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
   2. Provide complete description for each door listed.

D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
   2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
   3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

G. Keying Schedule:
   1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

H. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

1.07 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum eight years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least five years of documented experience.

D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
   1. Locksets and Cylinders: Three years, minimum.
   2. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.
   2. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   3. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), testing firm acceptable to authorities having jurisdiction, or _____ as suitable for application indicated.
   4. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
   1. Refer to Section 28 1000 for additional access control system requirements.

2.02 HINGES

A. Manufacturers:
   1. McKinney; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. C. R. Laurence Co., Inc; _____: www.crl-arch.com/#sle.
   3. Hager Companies; _____: www.hagerco.com/#sle.
   4. Stanley, dormakaba Group; _____: www.stanleyhardwarefordoors.com/#sle.

B. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Self Closing Hinges: Comply with BHMA A156.17.
   2. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
      a. Provide hinge width required to clear surrounding trim.
   3. Continuous Hinges: Comply with BHMA A156.26.
   4. Provide hinges on every swinging door.
   5. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   6. Provide ball-bearing hinges at each door with closer.
   7. Provide non-removable pins on exterior outswinging doors.
   8. Provide non-removable pins on interior outswinging doors at locations as indicated.
   9. Provide power transfer hinges where electrified hardware is mounted in door leaf.
   10. Provide following quantity of butt hinges for each door:
      a. Doors up to 60 inches (1.5 m) High: Two hinges.
      b. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
      c. Doors 90 inches (2.3 m) High up to 120 inches (3 m) High: Four hinges.
      d. Doors over 120 inches (3 m) High: One additional hinge per each additional 30 inches (762 mm) in height.

2.03 PIVOTS

A. Manufacturers:
   1. McKinney or Rixson; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. C. R. Laurence Company, Inc; _____: www.crl-arch.com/#sle.
   3. DORMA USA, Inc; LM Series: www.dorma.com/#sle.
   4. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Center-Hung and Offset Pivots: Comply with BHMA A156.4.

C. Self-Closing Pivots: Comply with BHMA A156.17.

D. Door Weight: Medium; standard openings with up to 650 lbs door weight.

2.04 FLOOR CLOSERS

A. Manufacturers:
1. Rixson; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. C. R. Laurence Company, Inc; _____: www.crl-arch.com/#sle.
3. DORMA USA, Inc; _____: www.dorma.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Floor Closers: Comply with BHMA A156.4, Grade 1.

2.05 FLUSH BOLTS

A. Manufacturers:
1. Adams Rite, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. Hager Companies; _____: www.hagerco.com/#sle.
3. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
4. Trimco; _____: www.trimcohardware.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Flush Bolts: Comply with BHMA A156.16, Grade 1.
1. Flush Bolt Throw: 3/4 inch (19 mm), minimum.
2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
   a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.

2.06 EXIT DEVICES

A. Manufacturers:
1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. C. R. Laurence Company, Inc; _____: www.crl-arch.com/#sle.
3. DORMA USA, Inc; 8000 Series, 9000 Series, DG1000 Series, and DG1100 Series: www.dorma.com/#sle.
4. Von Duprin, an Allegion brand; _____: www.allegion.com/us/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Exit Devices: Comply with BHMA A156.3, Grade 1.
1. Lever design to match lockset trim.
2. Provide cylinder with cylinder dogging or locking trim.
3. Provide exit devices properly sized for door width and height.
4. Provide strike as recommended by manufacturer for application indicated.
5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.07 ELECTRIC STRIKES

A. Manufacturers:
1. Adams Rite, HES, or Securitron; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Electric Strikes: Comply with BHMA A156.31, Grade 1.
1. Provide UL (DIR) listed burglary-resistant electric strike; style to suit locks.
2. Provide non-handed 24 VDC electric strike suitable for door frame material and scheduled lock configuration.

3. Provide field selectable Fail Safe/Fail Secure modes.
4. Provide transformer and rectifier as necessary for complete installation.
5. Connect electric strikes into fire alarm where non-rated doors are scheduled to release with fire or sprinkler alarm condition.

2.08 ELECTROMAGNETIC LOCKS

A. Manufacturers:
   1. Securitron; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.

B. Electromagnetic Locks: Comply with BHMA A156.23, Grade 1.
   1. Holding Force: 600 lbs (272 kgs), minimum.
   2. Voltage: 12 VDC, and provide power supplies by same manufacturer as locks.
   3. Mounting: Surface mounted to door and frame on secure side, with fasteners, brackets, and spacer bars as required for application.

2.09 LOCK CYLINDERS

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide cylinders from same manufacturer as locking device.
   2. Provide cams and/or tailpieces as required for locking devices.

2.10 CYLINDRICAL LOCKS

A. Manufacturers:
   1. Stanley, dormakaba Group; _____: www.stanleyhardwarefordoors.com/#sle.

B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
   1. Bored Hole: 2-1/8 inch (54 mm) diameter.
   2. Latchbolt Throw: 1/2 inch (12.7 mm), minimum.
   3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.

2.11 MORTISE LOCKS

A. Manufacturers:
   1. Basis of Design: Schlage, an Allegion brand; www.allegion.com/us.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
   1. Latchbolt Throw: 3/4 inch (19 mm), minimum.
   2. Deadbolt Throw: 1 inch (25.4 mm), minimum.
   3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.

2.12 DOOR PULLS AND PUSH PLATES

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. Forms+Surfaces; _____: www.forms-surfaces.com/#sle.
   3. Trimco; _____: www.trimcohardware.com/#sle.

B. Door Pulls and Push Plates: Comply with BHMA A156.6.
   1. Pull Type: Straight, unless otherwise indicated.
   2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
      a. Edges: Beveled, unless otherwise indicated.
   3. Material: Aluminum, unless otherwise indicated.

2.13 DOOR PULLS AND PUSH BARS

A. Manufacturers:

1. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. Trimco; _____: www.trimcohardware.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Door Pulls and Push Bars: Comply with BHMA A156.6.
1. Bar Type: Bar set, unless otherwise indicated.
2. Material: Aluminum, unless otherwise indicated.

2.14 COORDINATORS

A. Manufacturers:
1. DORMA USA, Inc; TS93 GSR: www.dorma.com/#sle.
2. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
3. Trimco; _____: www.trimcohardware.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.
1. Type: Bar, unless otherwise indicated.
2. Material: Aluminum, unless otherwise indicated.
3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.15 CLOSERS

A. Manufacturers; Surface Mounted:
1. C. R. Laurence Company, Inc; _____: www.crl-arch.com/#sle.
2. DORMA USA, Inc; 7400 Series, 8600 Series, 8900 Series, and TS93: www.dorma.com/#sle.
3. LCN, an Allegion brand; _____: www.allegion.com/us/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Manufacturers; Concealed - Overhead:
1. DORMA USA, Inc; RTS88: www.dorma.com/#sle.

C. Manufacturers; Concealed - Floor Mounted:
1. DORMA USA, Inc; BTS75V and BTS80: www.dorma.com/#sle.

D. Manufacturers; Low Energy for ADA Applications:
1. Stanley, dormakaba Group; D-4990 Series: www.stanleyhardwarefordoors.com/#sle.
2. Substitutions: See Section 01 6000 - Product Requirements.

E. Closers: Comply with BHMA A156.4, Grade 1.
1. Type: Surface mounted to door.
2. Provide door closer on each exterior door.

2.16 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:
1. Rixson or Sargent; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. C. R. Laurence Company, Inc; _____: www.crl-arch.com/#sle.
3. DORMA USA, Inc; 900 Series: www.dorma.com/#sle.
4. Glynn-Johnson, an Allegion brand; _____: www.allegion.com/us/#sle.

B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
1. Provide stop for every swinging door, unless otherwise indicated.

2.17 PROTECTION PLATES

A. Manufacturers:
1. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. C. R. Laurence Company, Inc; _____: www.crl-arch.com/#sle.
3. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
4. Trimco; _____: www.trimcohardware.com/#sle.

B. Protection Plates: Comply with BHMA A156.6.

C. Metal Properties: Aluminum.
   1. Metal, Heavy Duty: Thickness 0.062 inch (1.57 mm), minimum.

D. Edges: Beveled, on four sides unless otherwise indicated.

E. Fasteners: Countersunk screw fasteners.

2.18 KICK PLATES

A. Manufacturers:
   1. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
   2. Trimco; _____: www.trimcohardware.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 8 inch (203 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door.

2.19 MOP PLATES

A. Manufacturers:
   1. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
   2. Trimco; _____: www.trimcohardware.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Mop Plates: Provide along bottom edge of push side of doors to provide protection from cleaning liquids and equipment damage to door surface.
   1. Size: 6 inch (152 mm) high by 1-1/2 inch (38 mm) less door width (LDW) on pull side and 2 inch (51 mm) LDW on push side of door.

2.20 DOOR HOLDERS

A. Manufacturers:
   1. McKinney or Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. C. R. Laurence Company, Inc; _____: www.crl-arch.com/#sle.
   3. Trimco; _____: www.trimcohardware.com/#sle.

B. Door Holders: Comply with BHMA A156.16, Grade 1.
   1. Type: Lever, or kick down stop, with rubber bumper at bottom end.
   2. Material: Aluminum.

2.21 ELECTROMAGNETIC DOOR HOLDERS

A. Manufacturers:
   1. Rixson or Sargent; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. DORMA USA, Inc; EM Series: www.dorma.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Electromagnetic Door Holders: Comply with BHMA A156.15.
   1. Type: Wall mounted, single unit, standard duty, with strike plate attached to door.
   2. Holding Force, Standard Duty: 40 lbs-force (177 N), minimum.
   3. Voltage: 12 VDC, and provide power supplies by same manufacturer as holders.
   4. Provide interface with fire detectors and fire-alarm system for fire-rated door assemblies.

2.22 FLOOR STOPS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. Trimco; _____: www.trimcohardware.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Type: Manual hold-open, with pencil floor stop.
   2. Material: Aluminum housing with rubber insert.

2.23 WALL STOPS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. Trimco; _____: www.trimcohardware.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Type: Bumper, concave, wall stop.
   2. Material: Aluminum housing with rubber insert.

2.24 ASTRAGALS

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. National Guard Products, Inc; _____: www.ngpinc.com/#sle.
   3. Reese Enterprises, Inc; _____: www.reeseusa.com/#sle.
   4. Zero International, Inc; _____: www.zerointernational.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Astragals: Comply with BHMA A156.22.
   1. Type: Split, two parts, and with sealing gasket.
   2. Material: Aluminum, with neoprene weatherstripping.
   3. Provide non-corroding fasteners at exterior locations.

2.25 THRESHOLDS

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. National Guard Products, Inc; _____: www.ngpinc.com/#sle.
   3. Reese Enterprises, Inc; _____: www.reeseusa.com/#sle.
   4. Zero International, Inc; _____: www.zerointernational.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Thresholds: Comply with BHMA A156.21.
   1. Provide threshold at each exterior door, unless otherwise indicated.
   2. Type: Flat surface.
   3. Material: Aluminum.
   4. Threshold Surface: Fluted horizontal grooves across full width.
   5. Field cut threshold to profile of frame and width of door sill for tight fit.
   6. Provide non-corroding fasteners at exterior locations.

2.26 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   2. National Guard Products, Inc; _____: www.ngpinc.com/#sle.
   3. Reese Enterprises, Inc; _____: www.reeseusa.com/#sle.
   4. Zero International, Inc; _____: www.zerointernational.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Head and Jamb Type: Adjustable.
   2. Door Sweep Type: Encased in retainer.
   3. Material: Aluminum, with brush weatherstripping.

2.27 COAT HOOKS

A. Manufacturers:
   1. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.

B. Coat Hooks: Provide on room side of door, screw fastened.
   1. Material: Brass.

2.28 SILENCERS

A. Manufacturers:
   1. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
   2. Rockwood; an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
   1. Single Door: Provide three on strike jamb of frame.
   2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
   3. Material: Rubber, gray color.

2.29 FULL LENGTH 36" HIGH/LOW ACTUATOR (LOW PROFILE)

A. Manufacturers:
   1. BEA Inc. LPR36
   2. LCN (8310-836T for wired locations and 8310-836TW at wireless locations)

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Use templates provided by hardware item manufacturer.

D. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

E. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01 4000 - Quality Requirements.

3.04 ADJUSTING

A. Adjust work under provisions of Section 01 7000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

3.06 PROTECTION

A. Protect finished Work under provisions of Section 01 7000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION 08 7100

SECTION 08 8300
MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.

1.02 REFERENCE STANDARDS

A. ASTM C1036 - Standard Specification for Flat Glass; 2011.

B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

C. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Shop Drawings: Provide frameless mirrors with accessories as required for complete installation. Provide attachment details. Indicate where included in supplemental trade scope of work.

D. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.04 QUALITY ASSURANCE

A. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS).

1.05 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (mirror select); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
   1. Size: As noted on drawings.

2.03 ACCESSORIES

A. Trimless / Frameless

B. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

3.03 INSTALLATION

A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.
   1. Bottom Supports: Stainless steel angles, minimum 0.05" thickness; provide felt pads for setting mirrors on angles; provide concealed fasteners.
   2. Adhesive: Nontoxic type as recommended by mirror manufacturer.

3.04 CLEANING

A. Remove labels after work is complete.

B. Clean mirrors and adjacent surfaces.

END OF SECTION 08 8300

SECTION 09 0561

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in contract documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Broadloom carpet.
   3. Carpet tile.
   4. Thin-set ceramic tile and stone tile.

B. Preparation of new and existing concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

E. Patching compound.

F. Remedial floor coatings.

G. Preparation of new and existing wood-based floors and subfloors for installation of new floor coverings.

1.02 RELATED REQUIREMENTS

A. Section 01 2200 - Unit Prices: Bid pricing for remediation treatments if required.

B. Section 01 4000 - Quality Requirements: Additional requirements relating to testing agencies and testing.

C. Section 01 7419 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.

D. Section 03 3000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

E. Section 03 5400 - Cast Underlayment: Self-leveling underlayment applied as remediation treatment.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices: See Section 01 2200 - Unit Prices.

B. Unit Price for Alternate Flooring Adhesive: Do not include the cost of the alternate adhesive in the base bid; state on the bid form the unit price per square foot (square meter) for using the alternate adhesive, in the event such remediation is required.
   1. Base the unit price on a total quantity calculated by assuming that only 50 percent of the flooring will require the alternate adhesive.

C. Unit Price for Remedial Floor Coating or Sheet Membrane: Do not include the cost of the floor coating or underlayment in the base bid; state on the bid form the unit price per square foot (square meter) for the floor coating or underlayment, installed, in the event such remediation is required.

1.04 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

B. Contractor to provide both methods of moisture testing where moisture testing is recommended by flooring manufacturer.

1.06 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

B. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Include certification of accuracy by authorized official of testing agency.
   7. Submit report to Architect.
   8. Submit report not more than two business days after conclusion of testing.

C. Adhesive Bond and Compatibility Test Report.

1.07 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Owner.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Owner when specified ambient conditions have been achieved and when testing will start.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
   3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
   4. Patching compounds and joint fillers should include epoxy for use in high water table areas provided it is compatible for use with the new flooring.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
      a. Do not attempt to remove coating or penetrating material.
      b. Do not abrade surface.
   2. Preliminary cleaning.
   3. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
   4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   6. Specified remediation, if required.
   7. Patching, smoothing, and leveling, as required.
   8. Other preparation specified.
   9. Adhesive bond and compatibility test.
   10. Protection.

C. Remediations:
   1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
   2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
   3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the

level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.

F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.

C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.

D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with recommendations of testing agency.

C. Comply with requirements and recommendations of floor covering manufacturer.

D. Fully clean out all joints, such as surface cracks, grooves, depressions, control joints or other non-moving joints and other irregularities by mechanically “v-groove”.

E. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

F. Do not fill expansion joints, isolation joints, or other moving joints.

G. Follow all flooring material manufacturers’ recommendations regarding the successful installation procedures of the new proposed flooring.

H. Acclimate the room per flooring manufacturer’s recommendations regarding temperature, humidity and dew point prior to installing flooring materials.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.09 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 09 0561

SECTION 09 2116

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum sheathing.

F. Cementitious backing board.

G. Gypsum wallboard.

H. Joint treatment and accessories.

I. Acoustic (sound-dampening) wall and ceiling board.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 07 2100 - Thermal Insulation: Acoustic insulation.

C. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.

D. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.

E. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

F. Section 09 2216 - Non-Structural Metal Framing.

G. Section 09 3000 - Tiling: Tile backing board.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).

C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

F. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2014).

G. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2009).

H. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

J. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.

K. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.

L. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.

M. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.

N. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

O. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

P. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board; 2013.

Q. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2014.

R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.

S. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

T. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

U. ASTM E413 - Classification for Rating Sound Insulation; 2010.

V. GA-216 - Application and Finishing of Gypsum Board; 2013.

W. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.

X. GA-600 - Fire Resistance Design Manual; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate special details associated with fireproofing, acoustic seals, and trim accessories at exposed panel edges.
   1. Control Joints: Provide reduced plan showing location of proposed control joints.
      a. Place control joints according to ASTM C 840, as indicated in the Drawings, and in specific locations approved by Architect for visual effect.
   2. Reveals: Provide plans and details depicting all reveal details and locations.
   3. Backing: Provide plans indicating all coordinated backing locations.

C. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five years of experience.

B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions: All partitions are to receive sound insulation. Provide completed assemblies with the following characteristics:

1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.02 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
   1. Studs: "C" shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).

B. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
   1. Products:
      a. Same manufacturer as other framing materials.

C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
   3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
   4. Deflection and Firestop Track:
      a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
      b. Products:
         1) FireTrak Corporation; Posi Klip.
         2) Metal-Lite, Inc; The System.
   5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet (3660 mm).

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. National Gypsum Company: www.nationalgypsum.com/#sle.
   2. PABCO Gypsum: www.pabcogypsum.com.
   3. Quietrock: www.quietrock.com/products
   4. USG Corporation: www.usg.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold resistant board is required at all locations.
   3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.

4. Thickness:
    a. Ceilings: 1/2 inch (13 mm).
5. Mold Resistant Paper Faced Products:
    a. National Gypsum Company; Gold Bond XP Gypsum Board.
    b. National Gypsum Company; Gold Bond 3/4" Ultra-Shield FS XP Gypsum Board.
    c. Substitutions: See Section 01 6000 - Product Requirements.

C. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    a. Thickness: 1/2 inch (12.7 mm).
    b. Products:
        1) Custom Building Products: www.custombuildingproducts.com.
        2) USG Corporation: www.usg.com.

D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Type: Regular and Type X, in locations indicated.
4. Type X Thickness: 5/8 inch (16 mm).
5. Regular Board Thickness: 5/8 inch (16 mm).
6. Edges: Tapered.
7. Products:

E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 1/2 inch (13 mm).
3. Edges: Tapered.
4. Products:

F. Acoustical Sound Dampening Wall and Ceiling Board: Two layers of heavy paper faced, high density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of 50 or more in typical stud wall assemblies as calculated in accordance with ASTM E413 and when tested in accordance with ASTM E90.
1. Thickness: 1/2 inch (13 mm).
2. Long Edges: Tapered.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Products:
    a. Basis of Design: Pabco Gypsum, Quietrock
    b. National Gypsum Company; Gold Bond SoundBreak XP Gypsum Board: www.nationalgypsum.com/#sle.

G. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
4. Core Type: Regular and Type X, as indicated.
5. Type X Thickness: 5/8 inch (16 mm).
6. Regular Board Thickness: 5/8 inch (16 mm).
7. Edges: Square.
8. Glass Mat Faced Products:

a. National Gypsum Company; Gold Bond eXP Sheathing.

H. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (610 mm) wide, beveled long edges, ends square cut.
1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Products:
a. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: _____ inch (_____ mm).

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Water-Resistive Barrier: As specified in Section 07 2500.

D. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
3. Products:
a. Same manufacturer as framing materials.
b. Fry Reglet Corp.: www.fryreglet.com.

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

F. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion resistant.

I. Nails for Attachment to Wood Members: ASTM C514.

J. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

K. Adhesive for Attachment to Wood, ASTM C557 and Metal:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches (600 mm) on center.
2. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center (at 406 mm on center).
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.
   1. Orientation: Horizontal.
   2. Spacing: As indicated.

F. Acoustic Furring: Install resilient channels at maximum 24 inches (600 mm) on center. Locate joints over framing members.

G. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.

H. Blocking: Install mechanically fastened steel channel blocking for support of:
   1. Framed openings.
   2. Wall mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall mounted door hardware.
   7. Equipment
   8. Where indicated on the Drawings

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place two beads continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum

board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
   1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

E. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

G. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For non-rated assemblies, install as follows:
   1. Single-Layer Applications: Adhesive application.
   2. Double-Layer Application: Install base layer using screws or nails. Install face layer using screws, nails, or adhesive.

H. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
   1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
   2. Per the approved shop drawings.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 3: Walls to receive textured wall finish.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
   2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
   3. Taping, filling and sanding is not required at base layer of double layer applications.

C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION 09 2116

SECTION 09 2216

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal partition, ceiling, and soffit framing.

B. Framing accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 2100 - Thermal Insulation: Acoustic insulation.

B. Section 08 3100 - Access Doors and Panels.

C. Section 08 5200 - Wood Windows: Product requirements for window anchors.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.

E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.

F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

G. ASTM E413 - Classification for Rating Sound Insulation; 2010.

H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
   2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.

C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Sustainable Design Submittal: Documentation of recycled content and location of manufacture.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories:
   1. CEMCO: www.cemcosteel.com.
   2. ClarkDietrich Building Systems: www.clarkdietrich.com.
   3. SCAFCO Corporation: www.scafco.com/#sle.
   4. _____.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FRAMING MATERIALS

A. Fire Rated Assemblies: Comply with applicable code and as follows:

B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).
   1. Studs: C shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C shaped.
   4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).

C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating.
   3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
   4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet (3660 mm).

E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.

F. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.

G. Fasteners: ASTM C1002 self-piercing tapping screws.

H. Sheet Metal Backing: 0.036 inch (0.9 mm) thick, galvanized.

I. Acoustic Insulation: As specified in Section 07 2100.

J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

2.03 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

A. Comply with requirements of ASTM C754.

B. Extend partition framing to structure where indicated and to ceiling in other locations.

C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

E. Align and secure top and bottom runners at 24 inches (600 mm) on center.

F. At partitions indicated with an acoustic rating:
   1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.

G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

H. Install studs vertically at spacing indicated on drawings.

I. Align stud web openings horizontally.

J. Secure studs to tracks using fastener method. Do not weld.

K. Stud splicing is not permissible.

L. Fabricate corners using a minimum of three studs.

M. Double stud at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.

N. Brace stud framing system rigid.

O. Coordinate erection of studs with requirements of door frames and window frames; install supports and attachments.

P. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

Q. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.

R. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches (150 mm).

3.03 CEILING AND SOFFIT FRAMING AND FURRING

A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

B. Install furring independent of walls, columns, and above-ceiling work.

C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

D. Space main carrying channels at maximum 72 inch (1 800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Place furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.

G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches (600 mm) past each opening.

H. Laterally brace suspension system.

3.04 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation From Plumb: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION 09 2216

SECTION 09 2236.23

METAL SUSPENSION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ceiling framing.

1.02 RELATED REQUIREMENTS

A. Section 09 2216 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS

A. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2015a.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 FRAMING MATERIALS

A. Furring Channels: Formed steel, minimum 0.020 inch (0.5 mm) thick, 3/8 inch (10 mm) deep by 7/8 inch (22 mm) high, splicing permitted; galvanized.

B. Main Ceiling Channels: Formed steel, asphalt coated, minimum 0.05 inch (1.2 mm) thick, 3/4 inch (19 mm) deep by 1-1/2 inch (38 mm) high, single piece, no splicing; galvanized.

C. Resilient Channels: Formed steel, minimum 0.020 inch (0.5 mm) thick; serrated face, flattened Z profile, as indicated on the drawings, splicing permitted; galvanized.

D. Hangers: Steel wire, of size and type to suit application, to support ceiling components in place to deflection limits as indicated.

E. Ceiling Hangers: Rolled steel sections, of size and type to suit application, to rigidly support ceiling components in place to deflection limits as indicated; galvanized.

F. Lateral Bracing: Formed steel, minimum 0.060 inch (1.5 mm) thick, size and length as required; galvanized.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that substrates are ready to receive work and conditions are suitable for application.

C. Do not begin until unacceptable conditions have been corrected.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 CEILING AND SOFFIT FRAMING INSTALLATION

A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

B. Install furring independent of walls, columns, and above-ceiling work.

C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

D. Space main carrying channels at maximum 72 inch (1800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Install furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.

G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches (600 mm) past each opening.

H. Laterally brace suspension system.

3.03 CONTROL AND EXPANSION JOINT INSTALLATION

A. Locate joints as indicated on drawings and comply with ASTM C1063.
   1. Area of plaster panel not to exceed 144 sq ft (13.4 sq m) for vertical surfaces.
   2. Area of plaster panel not to exceed 100 sq ft (9.3 sq m) for horizontal, curved or angled surfaces.
   3. Spacing between control joints not to exceed 18 ft (5.5 m) in each direction.
   4. Area bounded by control joints not to exceed a length-to-width ratio of 2-1/2 to 1.

B. Install expansion joints where an expansion joint occurs in base exterior wall.

C. Install prefabricated joint accessories in accordance with ASTM C1063.

D. Construct expansion joints of back-to-back casing beads with a backer rod and sealant, set 1/4 inch (6 mm) apart.

3.04 ACCESS PANELS INSTALLATION

A. Install access panels and rigidly secure in place.

B. Install frames plumb and level in opening. Secure rigidly in place.

C. Position to provide convenient access to concealed work requiring access.

3.05 TOLERANCES

A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from True Position: 1/8 inch (3 mm).

END OF SECTION 09 2236.23

SECTION 09 2524

LIME BASED INTERIOR PLASTERING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Aged Slaked lime-based decorative plaster interior finish.

B. Related Sections:
   1. Section 09 21 16 - Plaster and Gypsum Board Assemblies
   2. [Sections specifying other substrates as appropriate].

1.02 REFERENCES:

A. A. ASTM E84 - Surface Burning Characteristics of Building Materials.

B. B. ASTM D1308-02 - Household Chemical Resistance.

C. C. ASTM D2486-06 - Scrub Resistance.

D. D. ASTM D3363 - Pencil Scratch and Gouge Hardness.

E. E. ISO 9002 - Quality systems -- Model for Quality Assurance in Production, Installation and Servicing.

1.03 SUBMITTALS

A. Product Data: Submit copies of manufacturer's product data for finishes and other materials provided under this Section including installation instructions.

B. Shop Drawing: Indicate designs, colors locations and relationship to adjoining surfaces.

C. Verification Samples: Submit two sets of samples eight by ten inches in size illustrating range of color[s] and texture[s] of selected Finish Codes, showing variation maximum to be expected in completed work.

D. D. Application Instructions: Submit complete manufacturer’s application instructions. Include requirements for preparation of surfaces, method of application of each finish, and recommended curing and protection methods.

E. Qualification Data: Submit a certificate indicating that installer is authorized by the manufacturer to install specified product.

F. Installer’s experience Record: Submit a list of at least 5 installations that have been installed for a minimum of 3 years of finish system similar in size, type and scope as described in this document. Include contact names and phone numbers.

G. Maintenance Data: Submit manufacturer’s recommended cleaning and maintenance data as specified in Section 01 74 00. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Finish shall be produced in ISO 9002 certified facility. Manufacturer shall be company specializing in manufacturing products specified in this section with minimum 4 years experience.

B. Installer: Installers shall be specially trained in the application of the finish. Installers shall have completed at least 5 installations of finishes similar to type included in this Section and shall have trained and certified by manufacturer.

C. Technical Representation: Arrange and pay for a factory technical representative to be present at the start of the work and to observe the work in progress for 6 hours.

D. Mock-up:
   1. Prior to installation of work of Section, apply sample [of each specified finish] approximately 4 feet by 4 feet in size at location directed by Architect.

2. Use specified materials and techniques to illustrate range of color[s], texture[s], and workmanship to be expected in completed work.
3. Retain approved mock-up retain until work has been completed and accepted. [Accepted mock-up may be incorporated into final work.]

E. Single Source Responsibility: Provide only proprietary, factory-formulated materials as produced by Texston Industries, Inc. specifically for application indicated. Substitutes within the system are not acceptable.

F. Pre installation Meeting: After approval of submittals but prior to beginning installation of work of this Section, conduct a meeting at the site attended by Architect, Contractor, installers of substrates to receive the mature slaked lime plaster finish, to describe in detail the necessary preparatory work to enable installation of the finish, and to establish agreement, coordination and responsibilities. Prepare a detailed report of this meeting and furnish copies to the Architect and all attendees.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Protect materials from direct sun in shipment, storage, and handling. Deliver materials in manufacturer's unopened packages, and store in dark and dry place between 45 and 95 degrees F.

1.06 WARRANTY

A. Manufacturer’s Limited Warranty: Provide Manufacturer’s five-years limited warranty against product defects.

PART 2 PRODUCTS

2.01 MANUFACTURER:

A. Basis of Design: Texston Industries, Inc; 8025 Deering Avenue, Canoga Park, CA 91304; 800-788-7113; www.Texston.com <http://www.texston.com/

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SYSTEM PERFORMANCE REQUIREMENTS

A. Composition: White, premixed paste containing finely ground marble, slaked lime (mature lime putty) which has been aged twelve months minimum, acrylic polymers, rheological additives, and mildewicidal and fungicidal admixtures.

B. Surface Burning: Class A; surface burning characteristics not exceeding Flame Spread = 0 and Smoke Density = 0 when tested according to ASTM E84.

C. Pencil Hardness: Gouge 6H/Scratch H when tested in accordance with ASTM- 3363

D. Scrub Resistance: Minimum of 10000 cycles using 10grams of scrubbing medium and 5 grams of water ASTM D2486-06.

E. Chemical exposure: ASTM D-1308-02- pass.

2.03 FINISH

A. Product: Texston Palladino™

B. Finish: As indicated in the drawings.

C. Color: As indicated in the drawings.

2.04 ACCESSORIES

A. Primer: Provide Texston primer of type compatible with substrate.

B. B. Sealer. Provide Texston recommended sealer.

C. C. Wax. Provide Texston wax of type compatible with Finish Code.

2.05 TOOLS

A. Use stainless steel trowels and spatulas of types recommended by manufacturer to produce results as indicated on approved submittals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect substrates and conditions affecting work of Section. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Mask and protect adjacent surfaces not scheduled to receive products of Section.

B. Substrate Preparation:
   1. Existing Substrates:
      a. Deteriorated Surfaces: Remove deteriorated substrates and patch in acceptable manner.
      b. Oily or Glossy Surfaces and Oil-Based Paint: Lightly sand prior to washing
      c. Wash with trisodium phosphate mixed at rate of indicated on product. Rinse, neutralize, and wipe dry.
   2. New Substrates:
      a. Gypsum wallboard: Level 5 finish.
      b. Interior plaster: Smooth steel trowel finish, flat within 1/8” in 10 feet.
   3. All Substrates shall be clean and free of contamination.

C. Prime: Apply primer in compliance with manufacturer direction.

3.03 MIXING

A. Mix materials to assure colorants are uniformly dispersed. If necessary, dilute with small amount of clean, potable water. Mix with clean tools and protect against entry of dust and debris into container.

3.04 APPLICATION

A. Comply with manufacturer’s installation requirements.

B. Apply in multiple coats or courses as required to obtain color and appearance of approved sample.

C. Apply only when temperature is between 45 to 95 degrees F in controlled environment. Protect from air flows of both natural and artificial.

3.05 SEALING/WAXING

A. A. Allow 24 hours for plaster substrate to dry before applying sealer.

B. B. Apply according to sealer manufacturer’s instructions. Protect against overspray.

3.06 CLEANING

A. Remove masking.

B. Adjacent Surfaces: Remove plaster using methods which will not damage surfaces.

3.07 PROTECTION

A. Protect finishes as required to assure that they will be without damage at Substantial Completion.

B. Repair damage in accordance with manufacturer’s instructions and to satisfaction of Architect.

3.08 FINISH SCHEDULE

A. Texston Palladino™
   1. Location: As indicated in the drawiings.
   2. Finish: As indicated in the drawings.
   3. Color: As indicated in the drawiings.

END OF SECTION 09 2524

SECTION 09 3000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Cementitious backer board as tile substrate.

D. Ceramic accessories.

E. Ceramic trim.

F. Non-ceramic trim.

1.02 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.

B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

C. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).

D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).

E. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).

G. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).

H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).

I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).

J. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

K. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).

L. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).

M. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).

N. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Tile: 10 square feet (1 square meters) of each size, color, and surface finish combination.

1.04 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

1.05 FIELD CONDITIONS

A. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products by the same manufacturer.
   1. Tile manufacturer and color as indicated on Drawings..

2.02 TRIM AND ACCESSORIES

A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.

B. Ceramic Trim: Matching bullnose, surface bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
   1. Applications:
      a. Open Edges: Bullnose.
      b. Inside Corners: Jointed.
      c. Floor to Wall Joints: Cove base.
   2. Manufacturers: Same as for tile.

C. Non-Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications:
      a. Transition between floor finishes of different heights.
      b. Thresholds at door openings.
      c. Expansion and control joints, floor and wall.
   2. Manufacturers:
      a. Schluter-Systems: www.schluter.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SETTING MATERIALS

A. Manufacturers:

B. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
   1. Products:
      a. Epoxy Adhesive; ANSI A118.3 thinset bond type.

2.04 GROUTS

A. Manufacturers:
   1. CEG-LITE Systems, Epoxy Grout.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORY MATERIALS

A. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch (12.7 mm) thick; 2 inch (51 mm) wide coated glass fiber tape for joints and corners.

B. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install ceramic accessories rigidly in prepared openings.

G. Install non-ceramic trim in accordance with manufacturer's instructions.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints. Epoxy grout.

L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with The Tile Council of North America Handbook Method as indicated below, with epoxy grout, unless otherwise indicated.
   1. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.

3.05 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

B. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.

C. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 3000

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustical units.

B. Supplementary acoustical insulation above ceiling.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 07 2100 - Thermal Insulation: Acoustical insulation.

C. Section 08 3100 - Access Doors and Panels: Access panels.

1.03 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

E. UL (FRD) - Fire Resistance Directory; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

C. Product Verification: Verify that the product specified under Part 2 matches and is identical to the product currently installed at the site.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

C. Product Data: Provide data on suspension system components and acoustical units.

D. Samples: Submit two samples 4 by 4 inch in size illustrating material and finish of acoustical units.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. USG; ____: www.usg.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of suspension system.

B. Acoustical Panels Type ACT1: USG Mars 88139
   1. Size: 24 by 24 inches
   2. Thickness: 1"
   3. NRC: 0.90
   4. Ceiling Attenuation Class (CAC): 20, determined in accordance with ASTM E1264.
   5. Panel Edge: F Fineline 1/8 DXFF

C. Acoustical Panels Type ACT2: USG Halcyon 98445
   1. Size: 48 by 48 inches
   2. Thickness: 1"
   3. NRC: 0.95
   4. Ceiling Attenuation Class (CAC): 20, determined in accordance with ASTM E1264.
   5. Panel Edge: FL Fineline

D. Acoustical Panels Type ACT3: USG Frost High #418 NRC/High CAC
   1. Size: 24 by 24
   2. Thickness: 3/4"
   3. NRC: 0.70
   4. Ceiling Attenuation Class (CAC): 40, determined in accordance with ASTM E1264.
   5. Panel Edge: FL Fineline

E. Acoustical Panels Type ACT4: USG Sheetrock Brand #3200 Lay-in Gypsum Ceiling Panels
   1. Size: 24 by 48
   2. Thickness: 1/2"
   3. NRC: ---
   4. Ceiling Attenuation Class (CAC): 40, determined in accordance with ASTM E1264.
   5. Panel Edge: Square Lay-in

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

B. Exposed Steel Suspension System Type ____: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Profile: Box, for reveal edge panels; 9/16 inch (14 mm) wide face.
   2. Construction: Double web.
   3. Finish: White painted.
   4. Products: As indicated in the drawings.

C. Exposed Steel Suspension System Type ACT-H: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Profile: Tee; 15/16 inch (24 mm) wide face.

2. Construction: Double web.
3. Finish: White painted.
4. Product: Donn Brand "DX" by USG.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid.
1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

C. Gypsum Board: Fire rated type; 5/8 inch (15 mm) thick, ends and edges square, paper faced.

D. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.

E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636/C 636M, ASTM E 580/E 580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

I. Support fixture loads using supplementary hangers located within 6 inches (150 mm) of each corner, or support components independently.

J. Do not eccentrically load system or induce rotation of runners.

K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Use longest practical lengths.
2. Miter corners.

L. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.

G. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.

H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

I. Install hold-down clips on panels within 20 ft (6 m) of an exterior door.
   1. Install hold-down clips in rooms designated for fire supression system, where required by manufacturerer.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 5100

SECTION 09 5426

SUSPENDED WOOD SLAT CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood slat ceiling.

1.02 REFERENCE STANDARDS

A. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.

B. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

C. Product Data: Provide data on suspension system components and ceiling panels.

D. Samples: Submit two full size samples illustrating material and finish of ceiling panels. Submit custom stain samples.

E. Samples: Submit two samples each, 6 inches (____ mm) long, of suspension system main runner, cross runner, and perimeter molding.

F. Test Reports: Submit substantiating engineering data, test results of previous tests by independent laboratory which purport to meet performance criteria, and other supportive data.

G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.04 QUALITY ASSURANCE

A. Designer Qualifications for Seismic Design: Under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the Project is located.

1.05 MOCK-UP

A. Provide 3 feet (____ m) by 1-1/2 feet (____ m) mock-up including suspension members, ceiling grid trim, and ceiling panels.

B. See Section 01 4000 - Quality Requirements for additional requirements.

C. Locate where directed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Suspended Wood Slat Ceilings:
   1. Basis of Design: Armstrong Woodworks Grille #7095.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SUSPENDED WOOD CEILING SYSTEM

A. Suspension System: Concealed Prelude 360 Black Grid

B. Slat Construction: 1" x 3-1/4" with 2" spacing

C. Acoustic Treatment: 1" Black acoustic panels above slats

D. NRC: 0.85

2.03 FABRICATION

A. Shop fabricate components.

B. Prepare components for mechanical and electrical openings as required and as shown on shop drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION

A. Install wall trim and corner medallions in accordance with manufacturer's installation instructions.

B. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

C. Support ceiling grid using clips and hanger wires spaced at maximum 48 inches (1200 mm) on center.

D. Cutting Panels and Grid Components: Using a sharp, small blade saw and straight edge, mark the finish side and cut as required. Miter cut corners.

E. Install border and edge panels, then full panels working across the room.

END OF SECTION 09 5426

SECTION 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet flooring.

B. Resilient tile flooring.

C. Resilient base.

D. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.03 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

B. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2015.

C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

D. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns.
   1. Clearly identify all scheduled material transitions for Architect verification.

D. Verification Samples: Submit two samples, ___ by ___ inch (___ by ___ mm) in size illustrating color and pattern for each resilient flooring product specified.

E. Concrete Testing Standard: Submit a copy of ASTM F710.

F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.

G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for final finishing, sealing, cleaning, stripping, and re-waxing.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Flooring Material: 50 square feet (4.65 square meters) of each type and color.
   3. Extra Wall Base: 20 linear feet (6 linear meters) of each type and color.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect roll materials from damage by storing on end.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.01 SHEET FLOORING

2.02 TILE FLOORING

A. Luxury Vinyl Tile:
   1. LVT-1 as indicated on the drawings.
   2. LVT-2 (Alt) as indicated on the drawings.

B. Woven Vinyl Tile
   1. WVT-1 as indicated on the drawings.

C. Vinyl Composition Tile
   1. VCT-1 as indicated on the drawings.

D. Static Dissipative Tile
   1. SDT-1 as indicated on the drawings.
   2. SDT-2 as indicated on the drawings.

E. Rubber Tile: Type I- Homogeneous, color and pattern throughout thickness; Type II- Heterogeneous, laminated.
   1. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
   2. Size: 12 by 12 inch (305 by 305 mm).
   3. Total Thickness: 0.125 inch (3.2 mm).

2.03 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Height: 6 inch (150 mm).
   2. Thickness: 0.125 inch (3.2 mm).
   3. Finish: As selected.
   4. Length: Roll.
   5. Accessories: Premolded external corners and internal corners.
      a. Ensure dye lot consistency for preformed corners prior to installation.
   6. Test in accordance with ASTM F710.

2.04 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Same material as flooring.

D. Filler for Coved Base: Plastic.

E. Sealer and Wax: Types recommended by flooring manufacturer.
   1. Submit final finishing data (sealant/wax) to Owner & Architect prior to application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
   1. Test in accordance with Section 09 0561.

D. Verify that concrete sub-floor and self leveling underlayment surfaces are dry enough and ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

D. Prohibit traffic until filler is fully cured.

E. Clean substrate.

F. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints and butt seams tightly.

E. Set flooring in place, press with heavy roller to attain full adhesion.

F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
   2. Resilient Strips: Attach to substrate using adhesive.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

I. At movable partitions, install flooring under partitions without interrupting floor pattern.

J. Install feature strips where indicated.

3.04 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

B. Seams are prohibited in bathrooms, kitchens, toilet rooms, and custodial closets.

3.05 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Install square tile to ashlar pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

3.06 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.07 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.08 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 6500

SECTION 09 6813

TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 7419 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap, removed carpet tile, and _____.

C. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.03 SUBMITTALS

A. See Section 01 3000 - 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.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.05 MOCK-UP

A. Provide 20 x 20 foot (3 x 3 m) installation of carpet tile, illustrating installed product, including pattern, seamining, and material transistion.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting:
   1. Shaw Industries Group, Shaw Floors.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. CPT-1 as indicated on the drawings.

B. CPT-1A as indicated on the drawings.

C. CPT-3 as indicated on the drawings.

D. CPT-4 as indicated on the drawings.

E. CPT-1 as indicated on the drawings.

2.03 ACCESSORIES

A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: Embossed aluminum, _____ color.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
   1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

E. Verify that concrete sub-floor and self leveling underlayment surfaces are dry enough and ready for flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by carpet tile manufacturer and adhesive materials manufacturer.

F. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in drawing indicated pattern, with pile direction alternating to next unit, set aligned as indicated on shop drawings.

F. Fully adhere carpet tile to substrate.

G. Trim carpet tile neatly at walls and around interruptions.

H. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

3.05 PROTECTION

A. Protect all installed floor coverings per manufacturer recommendations.

END OF SECTION 09 6813

TILE CARPETING

SECTION 09 6900

RAISED ACCESS FLOORING - EXTERIOR

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural floor supported pedestal framing system.

B. Removable floor panels.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for grid system, panels, and accessories; electrical resistance characteristics and ground connection requirements.

C. Shop Drawings: Indicate floor layout, interruptions to grid, special sized panels, panels requiring drilling or cut-out for services, appurtenances or interruptions, edge details, elevation differences, ramps, grilles, and registers.

D. Samples: Submit two samples of floor grid and panel, 24 by 24 inch (596 by 596 mm) in size illustrating finishes and color.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

G. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design floor system structure layout for this project under direct supervision of a Professional Structural Engineer experienced in design of floors of the type required and licensed in the State in which the Project is located.

1.06 MOCK-UP

A. Construct one mock-up, 3 feet (0.91 m) long by 3 feet (0.91 m) wide, with all specified accessories installed including ramp.

B. Locate where directed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Access Pedestals for Tile Pavers
   1. Basis of Design: Butech, Porcelanosa Group; (Normal Plot or Ultra Plot as needed)
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Access Flooring Tile Pavers:
   1. Basis of Design: Porcelanosa Urbatek
   2. Substitutions: See Section 01 6000 - Product Requirements.

C. Access Flooring Support Panels for Artificial Turf
   1. Basis of Design: FieldTurf 'VersaTile' 24"x21"
   2. Substitutions: See Section 01 6000 - Product Requirements

D. Artificial Turf
   1. Basis of Design: FieldTurf
   2. Turf Selection: Selection shall be made by the Architect from a range of the manufacturer's standard products.
   3. Substitutions: See Section 01 6000 - Product Requirements

2.02 ACCESS FLOORING - EXTERIOR

A. Access Flooring: Factory-fabricated system consisting of removable floor panels and supporting structure that allows access to each space below floor without requiring removal of panels other than the one directly above the space to which access is needed; provide all components and accessories required for complete installation and as indicated.
   1. Configuration: Stringerless system.
   2. Finished Floor Elevation: Top of access floor ____ inches (____ mm) nominal height above building structural floor.
   3. Floor Panel Size: 24 by 24 inches (600 by 600 mm).

B. Performance Requirements:
   1. Pedestals:
      a. Maximum Axial Load: 2204 lb (1000 kg) without permanent deformation.
         1) 'Normal Plot' Compression Resistance: 2204 lbs (1000 kg)
         2) 'Ultra Plot' Compression Resistance: 2645 lbs (1200 kg)
      b. Ultimate Strength: Not less than twice design load.
   2. Floor Panels: Conform to the following:
      a. Live Load: 250 lb/sq ft (11.9 kPa).
      b. Maximum Deflection: 0.04 inch (1 mm).
      c. Concentrated Load: 1,000 lb on 1 sq in (500 kg on 710 sq mm) at any location with maximum deflection of 0.08 inch (2 mm).
      d. Permanent Deformation: 0.02 inch (0.5 mm) maximum at design load.
      e. Ultimate Strength: Not less than twice design load.
      f. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   3. Lateral Stability: Design system for lateral stability in all directions, with or without panels in place.
   4. Surface Electrical Resistance: Maximum 1 ohm per panel.

2.03 COMPONENTS

A. Pedestals: Black polypropylene with calcium carbonate surface.
   1. Pedestals shall accommodate substrate slopes from 0% to 2%.
   2. Pedestals shall be adjustable and extend to a height of 100 mm minimum.
      a. Normal Plot: 50 mm min. / 100 mm max.
      b. Ultra Plot: 65 mm min. / 670 mm max.
   3. Separation between pavers: 4 mm
   4. Thread type: Double trapezoidal thread.

B. Paver Panels:
   1. Paver: Butech, Porcelanosa Group
      a. Size: 24" x 24" nominal (596 x 596 mm)
      b. Thickness: 7/8" (23 mm) approx.
      c. Load Capacity: 3kN
      d. Water Absorbtion: 0.5%
   2. Paver Face: Porcelanosa Urbatek
      a. Color: Shall be selected by Architect

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements are as shown on shop drawings.

B. Verify that required utilities are available, in proper location, and ready for use.

3.02 PREPARATION

A. Vacuum clean substrate surfaces.

3.03 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

B. Secure pedestal base plate to subfloor with adhesive.

C. Install additional pedestals where grid pattern is interrupted by room appurtenances or at cut-outs.

D. Install stringers and floor panels on pedestals with full bearing.

3.04 TOLERANCES

A. Maximum Out of Level Floor Panel Tolerance: 1/16 inch in 10 ft (1.6 mm in 3 m), non-cumulative.

3.05 ADJUSTING

A. Adjust pedestals to achieve a level floor and to assure adjacent floor panel surfaces are flush.

3.06 PROTECTION

A. Do not permit traffic over unprotected floor surface.

END OF SECTION 09 6900

SECTION 09 7200
WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall covering and borders.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Preparation and priming of substrate surfaces.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on wall covering and adhesive.

C. Shop Drawings: Indicate wall elevations with seaming layout.

D. Samples: Submit two samples of wall covering, 18 by 18 inch in size illustrating color, finish, and texture.

E. Test Reports: Indicate verification of flame and smoke ratings, when tested by an agency approved by authority having jurisdiction.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

G. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Wall Covering Materials: 25 linear feet (8 linear m) of each color and pattern of wall covering; store where directed.
   3. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 MOCK-UP

A. Provide two full panel mock-ups of WC-4.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. General Requirements:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   2. For Wall Coverings WC-1 through WC-13, provide as indicated on the drawings.
   3. For Fabric Wrapped Panels FWP-1 through FWP-3, provide as indicated on the drawings.
   4. For Wood Wall Coverings WD-2 & WD-5, provide as indicated on the drawings.

B. Wall Covering WC-1 as indicated on the drawings.

C. Wall Covering WC-2 as indicated on the drawings.

D. Wall Covering WC-3 as indicated on the drawings.

E. Wall Covering WC-4 as indicated on the drawings.

F. Wall Covering WC-7 as indicated on the drawings.

G. Wall Covering WC-8 as indicated on the drawings.

H. Wall Covering WC-9 as indicated on the drawings.

I. Wall Covering WC-10 as indicated on the drawings.

J. Wall Covering WC-11 as indicated on the drawings.

K. Wall Covering WC-12 as indicated on the drawings.

L. Wall Covering WC-13 as indicated on the drawings.

M. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

N. Termination Trim: Fry Reglet as necessary. Refer to drawings, clear.

O. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

P. Substrate Primer and Sealer: Alkyd enamel type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet (3 mm in 3 m) nor vary at a rate greater than 1/16 inch/ft (1.5 mm/300 mm).

3.02 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.

E. Apply one coat of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth.

F. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall surface immediately prior to application of wall covering.

C. Use wall covering in pattern sequence.

D. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.

E. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

F. Horizontal seams are not acceptable.

G. Do not seam within 2 inches (50 mm) of internal corners or within 6 inches (150 mm) of external corners.

H. Install wall covering before installation of bases, cabinets, and hardware and items attached to or spaced slightly from wall surface.

I. Do not install wall covering more than 1/4 inch (6 mm) below top of resilient base.

J. Cover spaces above and below windows, above doors, in pattern sequence from roll.

K. Where wall covering tucks into reveals, or metal wallboard or plaster stops, apply with contact adhesive within 6 inches (150 mm) of wall covering termination. Ensure full contact bond.

L. Install termination trim.

M. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION 09 7200

SECTION 09 8400
ACOUSTICAL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustical ceiling panels

B. Acoustical plaster panels

C. Exposed suspension sytem

D. Wire hangers, fasteners, and hardware.

1.02 RELATED REQUIREMENTS

A. Section 09 5100 - Acoustical Ceilings.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.

D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.

E. Verification Samples: Fabricated samples of each type of panel specified; 12 x 12 in (305 x 305 mm), showing construction and edge details.

F. LEED Submittal: Documentation of recycled content and location of manufacture.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical panels from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until panels are needed for installation.

B. Store panels flat, in dry, well-ventilated space; do not stand panels on end.

C. Protect panel edges from damage.

1.05 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.

B. Construct mock-up of acoustical panels at location indicated by Architect.
   1. Minimum mock-up dimensions: 96 x 96 inches (2440 x 2440 mm).
   2. Approved mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fabric Wrapped Panel FWP-1: See data as indicated on the drawings.

B. Fabric Wrapped Panel FWP-2: See data as indicated on the drawings.

C. Fabric Wrapped Panel FWP-3: See data as indicated on the drawings.

D. Acoustical Wall Tiles AT-1: See data as indicated on the drawings.

2.02 FABRICATION

A. General: Fabricate panels to sizes and configurations indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.

B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 in (1.6 mm) for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

A. Ceiling-Suspended Accessories: Manufacturer's standard through-threaded eyelets bolted through concealed perimeter frame at 1/4 points on each panel, sized appropriately for weight of panels.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical panels. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical panels in locations indicated, following installation recommendations of panel manufacturer. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

B. Suspend ceiling baffles at locations and heights indicated.

C. Install panels to construction tolerances of plus or minus 1/16 in (1.6 mm) for the following:
   1. Plumb and level.
   2. Flatness.

3.03 CLEANING

A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

B. Remove surplus materials, trimmed portions of panels, and debris resulting from installation.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until completion of the work.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION 09 8400

SECTION 09 9000
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, stains, varnishes, and other coatings.

C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Exposed surfaces of steel lintels and ledge angles.
   3. Prime surfaces to receive wall coverings.
   4. Mechanical and Electrical:
      a. In finished areas galvanized ductwork and galvanized conduit shall be left unpainted. Galvanized duct hangers and galvanized electrical junction boxes shall be also left unpainted.
      b. In all areas, paint shop-primed items.
      c. On the roof and outdoors, paint all equipment that is exposed to weather or to view, including that which is factory-finished.
      d. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
      e. Paint dampers exposed behind louvers, grilles, to match face panels.

D. Do Not Paint or Finish the Following Items:
   1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne, and lead items.
   7. Marble, granite, slate, and other natural stones.
   8. Floors, unless specifically so indicated.
   9. Ceramic and other tiles.
   10. Glass.
   11. Acoustical materials, unless specifically so indicated.
   12. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Shop-primed items.

B. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Painted identification.

C. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Color coding scheme for items to be painted under this section.

D. Section 22 0553 - Identification for Plumbing Piping and Equipment: Painted identification.

E. Section 22 0553 - Identification for Plumbing Piping and Equipment: Color coding scheme for items to be painted under this section.

F. Section 23 0553 - Identification for HVAC Piping and Equipment: Painted identification.

G. Section 23 0553 - Identification for HVAC Piping and Equipment: Color coding scheme for items to be painted under this section.

H. Section 26 0553 - Identification for Electrical Systems: Painted identification.

I. Section 26 0553 - Identification for Electrical Systems: Color coding scheme for items to be painted under this section.

1.03 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

D. GreenSeal GS-11 - Paints and Coatings; 2013.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Samples: Submit two painted samples, illustrating selected colors, high saturation and accent colors, special coatings and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 12 x 12 inch (300 x 300 mm) in size.
   1. Obtain final list of required mock-up colors from Architect during draw down review.

C. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.

D. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.

E. Manufacturer's Instructions: Indicate special surface preparation procedures.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Paint and Coatings: 5t gallons (19 L) of each color and type; store where directed.
   3. Label each container with color, type, and room locations in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience.

1.07 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Provide door and frame assembly illustrating stain and varnish coating color, texture, and finish.

C. Locate where directed.

D. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish and stain Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Paints:
   1. Benjamin Moore & Co: www.benjaminmoore.com/#sle.
   2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   3. Dunn-Edwards Paints: www.dunn-edwards.com..

C. Transparent Finishes:
   1. Same as for Paints.

D. Stains:

E. Primer Sealers: Same manufacturer as top coats.

F. Block Fillers: Same manufacturer as top coats.

G. Non-Toxic Paints:
   1. Southern Diversified Products, Mythic Paint: www.mythicpaint.com

H. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each coating material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile Organic Compound (VOC) Content:

1. Provide coatings that comply with the most stringent requirements specified in the following:
    a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

D. Colors: As indicated on drawings
1. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the mechanical and electrical specifications.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint CE-OP-3L - Masonry/Concrete, Opaque, Latex, 3 Coat:
1. One coat of block filler.
2. Flat: Two coats of latex enamel; Evershield W 701.

B. Paint GE-OP-3L - Gypsum Board and Plaster, Opaque, Latex, 3 Coat:
1. One coat of latex primer sealer.
2. Flat: Two coats of latex; Evershield W 701.

C. Paint ME-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
1. One coat of latex primer.
2. Semi-gloss: Two coats of latex enamel; Permasheen W 901.

D. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
2. Semi-gloss: Two coats of latex enamel; Permasheen W 901.

E. Paint MgE-OP-3L - Galvanized Metals, Latex, 3 Coat:
1. One coat epoxy.
2. Semi-gloss: Two coats of latex enamel; Permasheen W 901.

F. Paint MaE-OP-3L - Aluminum and Copper, Unprimed, Latex, 3 Coat:
1. One coat etching primer.
2. Semi-gloss: Two coats of latex enamel; Permasheen W 901.

G. Paint E-Pav - Pavement Marking Paint:
1. Yellow: One coat, with reflective particles .

2.04 PAINT SYSTEMS - INTERIOR

A. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:
1. One coat of latex primer sealer.
2. Semi-gloss: Two coats of latex enamel; Permasheen W 901V.
3. Eggshell: Two coats of latex enamel; Permashell W 940V.

B. Paint WI-TR-VS - Wood, Transparent, Varnish, Stain:
1. One coat of stain.
2. One coat sealer; Heirloom Sanding Sealer 80-6200.
3. Satin: One coat of varnish; Heirloom W/B Polyurethane Satin MC 80-6841.

C. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
1. One coat of latex primer.
2. Semi-gloss: Two coats of latex enamel; Permasheen W 901V.

D. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with latex primer.
2. Semi-gloss: Two coats of latex enamel; Permasheen W 901V.

E. Paint MgI-OP-3L - Galvanized Metals, Latex, 3 Coat:
1. One coat galvanize primer.
2. Semi-gloss: Two coats of latex enamel; Permasheen W 901V.

F. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat:
   1. One coat of latex primer sealer.
   2. Semi-gloss: Two coats of latex-acrylic enamel; Permasheen W 901V.
   3. Eggshell: Two coats of latex-acrylic enamel; Permasheen W 904V.

G. Paint GI-OP3NT - Gypsum Board/Plaster, Vinyl Acrylic Latex Coating Zero VOC, 3-coat
   1. One coat of latex primer sealer. Interior Drywall Primer MP801
   2. Semi-gloss: Two coats of latex-acrylic enamel; Interior Acrylic Semi-Gloss Enamel MP102.
   3. Eggshell: Two coats of latex-acrylic enamel; Interior Latex Eggshell Enamel MP 101.

H. Video Projection Screen Coating:
   1. Basis of Design: Goo Systems Global; Screen Goo
   2. Color: As indicated in the drawings.
   3. Application: Provide as recommended by the manufacturer.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of coatings until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing coatings that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

I. Insulated Coverings to be Painted: Remove dirt, grease, and oil from canvas and cotton.

J. Concrete Floors and Traffic Surfaces to be Painted: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

K. Copper Surfaces to be Painted: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.

L. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

M. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).

N. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

O. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

P. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

Q. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

R. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

S. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's instructions.

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

F. Sand wood and metal surfaces lightly between coats to achieve required finish.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

B. Owner will provide field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finished coatings until completion of project.

B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION 09 9000

SECTION 10 2113.13
METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal toilet compartments, (floor mounted).

B. Urinal screens.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Concealed steel support members.

B. Section 06 1000 - Rough Carpentry: Blocking and supports.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

C. Product Data: Provide data on panel construction, hardware, and accessories.

D. Samples: Submit two samples of partition panels, 4 x 4 inch (100 x 100 mm) in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Toilet Compartments:
   1. General Partitions Mfg. Corp: www.generalpartitions.com.
   2. Global Steel Products Corp: www.globalpartitions.com.
   3. Metpar Corp: www.metpar.com.
   4. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

2.03 COMPONENTS

A. Toilet Compartments: Vandal proof stainless steel, floor-mounted unbraced.

B. Doors, Panels, and Pilasters: Sheet steel faces, pressure bonded to sound deadening core, formed and closed edges; corners made with corner clips or mitered, welded, and ground smooth.
   1. Panel Faces: 20 gage, 0.0359 inch (0.91 mm).
   2. Door Faces: 22 gage, 0.0299 inch (0.76 mm).
   3. Pilaster Faces: 20 gage, 0.0359 inch (0.91 mm).
   4. Reinforcement: 12 gage, 0.1046 inch (2.66 mm).
   5. Internal Reinforcement: Provide in areas of attached hardware and fittings. Mark locations of reinforcement for partition mounted washroom accessories.

C. Door and Panel Dimensions:
   1. Thickness: 1 inch (25 mm).
   2. Door Width: 24 inch (610 mm).
   3. Door Width for Handicapped Use: 36 inch (915 mm), out-swinging.

4. Height: 58 inch (1473 mm).

D. Pilasters: 1-1/4 inch (32 mm) thick, of sizes required to suit compartment width and spacing.

E. Urinal Screens: Stainless steel sheet 30 inch (760 mm) wide x 42 inch (1 066 mm) high mounted on partitions or walls adjacent to urinals. Fasten with stainless steel screws spaced 8 inches (20 mm) on center.

2.04 ACCESSORIES

A. Pilaster Shoes: Formed chromed steel with polished finish, 3 inch (175 mm) high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Brackets: Polished chrome-plated non-ferrous cast metal.

C. Attachments, Screws, and Bolts: Stainless steel .
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts .

D. Hardware: Polished chrome plated non-ferrous cast metal:
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Thumb turn or sliding door latch with exterior emergency access feature.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one per compartment, mounted on door.
   5. Provide door pull for outswinging doors.

2.05 FINISHING

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that field measurements are as indicated.

C. Verify correct spacing of and between plumbing fixtures.

D. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1/2 inch (9 to 13 mm) space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

E. Field touch-up of scratches or damaged enamel finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch (6 mm).

B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).

B. Adjust hinges to position doors in partial opening position when unlatched. Return out swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 10 2113.13

SECTION 10 2113.16

PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plastic laminate toilet compartments.

1.02 RELATED REQUIREMENTS

A. Section 10 2800 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2009.

B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

C. PS 1 - Structural Plywood; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

C. Product Data: Provide data on panel construction, hardware, and accessories.

D. Samples: Submit two samples of partition panels, 6 by 6 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plastic Laminate Toilet Compartments:
   1. General Partitions Mfg. Corp; ____: www.generalpartitions.com/#sle.
   2. Accu Tec; www.accutecmfg.com
   3. Metpar; www.metpar.com
   4. Global Steel Products Corp; ____: www.globalpartitions.com/#sle.
   5. Bobrick.
   6. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Plywood for Core: Softwood, PS 1 Grade B-B, Exterior grade.

B. Particleboard for Core: ANSI A208.1; composed of wood chips, sawdust or flakes, made with waterproof resin binder; of grade to suit application; sanded faces.

C. Plastic Laminate: NEMA LD 3, HGS.

D. Adhesive: Contact type.

2.03 COMPONENTS

A. Toilet Compartments: Plastic laminate finished, floor-mounted unbraced.

B. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces and edges of particleboard core, with beveled corners and edges; edges of cut-outs sealed.
   1. Plastic Laminate Color: as indicated on the drawings, textured, low gloss finish.

C. Door and Panel Dimensions:
   1. Thickness: 1 inch (25 mm).
   2. Door Width: 24 inch (610 mm).

3. Door Width for Handicapped Use: 36 inch (915 mm), out-swinging.
4. Height: 9" above the floor and 18" below the ceiling.
5. Thickness of Pilasters: 1-1/4 inch (32 mm).

D. Urinal Screens: Wall mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and ceiling.

2.04 ACCESSORIES

A. Pilaster Shoes: Formed chromed steel with polished finish, 3 inches (75 mm) high, concealing floor fastenings.
1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.

B. Wall and Pilaster Brackets: Polished stainless steel.

C. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.

D. Steel Plate Reinforcement: Carbon steel, prepared for fasteners, 1/8 inch (3 mm) thick.

E. Hardware: Polished stainless steel:
1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
2. Thumb turn door latch with exterior emergency access feature.
3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
4. Coat hook with rubber bumper; one per compartment, mounted on door.
5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1/2 inch (9 to 13 mm) space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch (6 mm).

B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 10 2113.16

SECTION 10 2213
WIRE MESH PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wire mesh systems for walls.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Cylinders for locksets.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

C. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2013.

D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.

E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for mesh materials, finishes.

C. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, anchorage, and type and location of fasteners.
   1. Show field measurements on shop drawings.

D. Samples: Submit two _____, 8 by 8 inch (____by____ mm) in size, illustrating mesh material. Submit samples of hinge and latchset illustrating style, color, and finish. Incorporate sample into the Work.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than eight years ofdocumented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wire Mesh Partitions:
   1. Basis of Design: Southwest Solutions Group; www.southwestsolutions.com
   2. Alternates:Other manufacturers which might be capable of providing comparable product include the following listed below. It is the responsibility of any supplier providing product for the project to demonstrate that the proposed item meets the requirements of the specifications including equivalent performance characteristics to the ‘Basis of Design’. If an ‘Alternate’ manufacturer is utilized, submit product documentation pursuant to the Div. 1 requirements for ‘Substitutions’ as describe in Section 012500.
      a. Acorn Wire and Iron Works, Inc; ____: www.acornwire.com/#sle.
      b. The G-S Company; Sure Guard Standard Duty: www.g-sco.com/#sle.
      c. Miller Wire Works, Inc; ____: www.millerwireworks.com/#sle.

3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 WIRE MESH PARTITIONS

A. Wire Mesh Partitions: Factory-fabricated modular assemblies of panels, doors, anchors, hardware, and accessories as required to provide a complete system.
   1. Design Criteria:
      a. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.
      b. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
   2. Performance:
      a. Installed Wall Assembly: Resist a lateral load of 5 lbs per square foot without damage or permanent set.

2.03 COMPONENTS

A. Woven Wire Mesh: Standard duty.
   1. Material: ASTM A510/A510M uncoated crimped steel wire.
   2. Wire Size: 10 gage, 0.135 inch (3.5 mm).
   3. Mesh Opening Size: 1-1/2 inch (38 mm) diamond shape.
   4. Mesh Weave: Plain weave, inter-crimped.

B. Framing and Support Members:
   1. Material: ASTM A36/A36M steel shapes and ASTM A500/A500M cold-formed steel.
   2. Framing, Corner Posts, and Intermediate Support Members: Manufacturer's standard sizes for system specified and as indicated on drawings.

C. Doors: Same material as partitions, fully framed; manufacturer's standard construction for sliding and swinging operation as indicated.
   1. Hinged doors shall be constructed of the same materials as the panels with two 1/4" x 3/4" horizontal stiffeners across the width, and two diagonal 1/4" x 3/4" stiffeners from center to the corner. Hinged doors shall be equipped with padlock lugs (cylinder lock optional), three 4" x 4" spun pin hinges, and pick plate/slam bar assembly.
   2. Sliding doors shall be constructed of the same materials as the panels with two 1/4" x 3/4" horizontal stiffeners across the width, and two vertical 1/4" x 3/4" stiffeners from center to top or bottom. Sliding doors shall be equipped with two 4 wheel trolley trucks, 1 7/8" x 2 3/8" door track, pad lock lugs (cylinder lock optional), and door keeper assembly.

D. Sheet Metal Base Panel: ASTM A1008/A1008M, cold rolled steel sheet.

E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.04 FASTENERS

A. Bolts, Nuts and Washers: Hot dip galvanized.

B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

2.05 ACCESSORIES

A. Bracing: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

C. Post Caps: Manufacturer's standard.

D. Floor and Ceiling Pilaster Shoe: Manufacturer's standard.

E. Floor Base: Manufacturer's standard.

2.06 FABRICATION

A. Fit and assemble in largest practical sections for delivery to site, ready for installation.

B. Make exposed joints flush or tight.

2.07 FINISHES

A. Painted Finish: Manufacturer's standard powder coat finish.

1. Color: To be selected by the Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that substrate surfaces and required openings are ready to receive work.

3.02 PREPARATION

A. Clean substrate surfaces.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install items plumb and level, accurately fitted, free from distortion or defects.

3.04 TOLERANCES

A. Maximum Variation From Plumb or Level: 1/4 inch (6 mm).

B. Maximum Misalignment From True Position: 1/4 inch (6 mm).

3.05 ADJUSTING

A. Adjust doors to achieve free movement.

3.06 CLEANING

END OF SECTION 10 2213

SECTION 10 2601

WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

1.02 RELATED REQUIREMENTS

A. Section 092116: Wall construction.

B. Section 05 5000 - Metal Fabrications: Anchors for attachment of work of this section, concealed in wall.

C. Section 06 1000 - Rough Carpentry: Blocking for wall and corner guard anchors.

D. Section 09 7200 - Wall Coverings: Terminating wall covering at corner guard.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.

C. Shop Drawings: Provide plans which depict all locations and details associated ith corner guard construction and installation..

D. Samples: Submit two sections of corner guard, 24 inch (600 mm) long, illustrating component design, configuration, color and finish.

E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Corner Guards - Surface Mounted: Extruded one-piece unit without splices, installed with adhesive.
   1. Material: Black Stainless Steel
   2. Height: Full height of wall as noted on the drawings.
   3. Height: 4' High as noted on the drawings.
   4. Edge: Taper edge from corner to wing termination.

2.02 FABRICATION

A. Fabricate components with tight joints, corners and seams.

B. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.

B. Position corner guard from top of base to 1/2 inches (13 mm) below ceiling.

C. Coordinate installation of wall covering with corner guard cover.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch (6 mm).

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

END OF SECTION 10 2601

SECTION 10 2800

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Under-lavatory pipe supply covers.

D. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 8300 - Mirrors: Other mirrors.

B. Section 09 3000 - Tiling: Ceramic washroom accessories.

C. Section 10 2113.13 - Metal Toilet Compartments.

D. Section 10 2113.16 - Plastic-Laminate-Clad Toilet Compartments.

E. Section 22 4000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. Basis of Design: Bobrick
   2. Alternate Manufacturers:
      a. AJW Architectural Products; _____: www.ajw.com/#sle.
      b. American Specialties, Inc; _____: www.americanspecialties.com/#sle.
      c. Bradley Corporation; _____: www.bradleycorp.com/#sle.
      d. Georgia-Pacific Professional; _____: www.blue-connect.com/#sle.
   3. Substitutions: Section 01 6000 - Product Requirements.

2.02 COMMERCIAL TOILET ACCESSORIES

A. See Toilet Accessory Schedule as indicated in the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 2800

SECTION 10 4400

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. AED Cabinet, fully recessed, not alarmed.

D. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 092116: Roughed-in wall openings.

B. Section 09 9123 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; current edition.

B. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

C. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Product Verification: Verify that the product specified under Part 2 matches and is identical to the product currently installed at the site.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.06 QUALITY ASSURANCE

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.07 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable 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

2.01 MANUFACTURERS

A. Fire Extinguishers:

1. Ansul, a Tyco Business; ____: www.ansul.com/#sle.
2. Pyro-Chem, a Tyco Business; _____: www.pyrochem.com/#sle.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
   2. Provide extinguishers as indicated in the drawings.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size and classification as scheduled.
   3. Finish: Baked polyester powder coat, color as selected.
   4. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to ___ degrees F (___ degrees C).

2.03 FIRE EXTINGUISHER CABINETS

A. Cabinet Configuration: Recessed type.
   1. Size to accommodate accessories.

B. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.

C. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.

D. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

E. Weld, fill, and grind components smooth.

F. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.

2.04 AED CABINET

A. Basis of Design: Cardia Science; www.cardiascience.com

B. Fully recessed cabinet without alarm.

2.05 ACCESSORIES

A. Cabinet Signage: Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER.".
   1. Location: Applied to cabinet glazing.
   2. Application Process: Silk-screened.
   3. Lettering Color: Red.
   4. Orientation: Vertical.

2.06 FINISHES, GENERAL

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. Finish fire-protection cabinets after assembly.

D. 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.

2.07 STAINLESS-STEEL FINISHES

A. General: Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Sheet finish designations below are frequently used to specify finishes applied after fabrication.

C. Satin, Directional Polish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings as indicated in the drawings.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

E. Position cabinet signage at locations indicated.

3.03 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties 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 manufacturer.

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 10 4400

SECTION 10 7313

EXTERIOR SUN CONTROL FABRIC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sun control fabric for non-retractable tensile shade tarp.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on awning covering, color fastness, stitching and seaming methods, attachment devices to framing system, and _____.

C. Shop Drawings: Indicate awning profiles, sizes, connection attachments, anchorage, size and type of fasteners, graphic images, patterns, and accessories.

D. Samples, Covering: Submit 12 by 12 inch (300 by 300 mm) sample of covering with representative hem stitch detail, seam with reinforcement, and attachment devices to framing system.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire resistance ratings for sun control fabric.

B. Conform to applicable code for positive and negative wind design loads.

1.04 WARRANTY

A. Provide a 5 year manufacturer's warranty for the fabric

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Serge Ferrari Soltis Horizon 86.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COVERING MATERIALS

A. Fabric Characteristics/Requirements:
   1. Thickness: 0.45mm
   2. Tensile Strength: 230/160 daN / 5 cm
   3. Tear Strength: 45 / 20 daN
   4. Flame Retardancy: Class A / ASTM E84
   5. Openess Factor: 14%
   6. Weight: 380 g/m2
   7. Maximum Width: 177 cm
   8. Maximum Length: 50 lm @ 177 cm width

2.03 FABRICATION - COVERING

A. Manufacture covering in one piece wherever possible, sized and configured to suit framing.

END OF SECTION 10 7313

SECTION 10 8213

ROOF MECHANICAL EQUIPMENT SCREENS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stand-alone roof equipment screens and supporting steel framework. Screens shall be designed to attach to the roof structure and not the equipment being screened.

B. Roof screen accessories.

1.02 RELATED SECTIONS

A. Section 051200 - Structural Steel: Metal Framing.

B. Section 055000 - Metal Fabrications: Frames and supports.

C. Section 099100 - Paints and Coatings: Field applied paint finish.

D. Division 23 - Roof Top HVAC Equipment.

1.03 REFERENCES

A. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

B. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. ASTM A 1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

E. ASTM B 749 - Standard Specification for Lead and. Lead Alloy Strip, Sheet, and Plate Products.

F. ASTM D 4811 - Standard Specification for Nonvulcanized (Uncured) Rubber Sheet Used as Roof Flashing.

G. ASTM D 6878 - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing.

H. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

J. AWS D1.1 - Structural Welding Code - Steel.

K. AWS D1.6 - Structural Welding Code - Stainless Steel.

1.04 COORDINATION

A. Coordinate Work with other operations and installation of roofing materials to avoid damage to installed insulation and membrane materials.

1.05 ACTION SUBMITTALS

A. Submit under provisions of Section 013300.

B. Product Data: 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: Layout and erection drawings showing typical cross sections and dimensioned locations of all frames and base supports. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, shape, and patterns.

1.06 INFORMATIONAL SUBMITTALS

A. Design Calculations: 3 copies of structural design calculations for structural components and components resisting wind loads with seal and signature of professional engineer licensed in the State of [insert state name].

B. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

D. Warranties: 3 signed copies.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with a minimum five years documented experience in producing pre-manufactured metal-framed equipment screens.

B. Design Qualifications: Provide structural design calculations stamped by a professional engineer licensed in the state in which this project is located.

C. Welders: AWS certified within previous 12 months.

D. Pre-Installation Meeting:
   1. Convene at job site, at least seven calendar days prior to scheduled beginning of construction activities of this section, to review requirements of this section.
   2. Require attendance by representatives of the installing subcontractor (who will represent the system manufacturer), the mechanical subcontractors and other entities affected by construction activities of this section.
   3. Notify Architect four calendar days in advance of scheduled meeting date.

E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Locate in area designated by Architect.
   2. Construct mock-up, one full screen section wide, including two roof supports.
   3. Do not proceed with remaining work until workmanship, color, and location is approved by Architect.
   4. Remove mock-up if required by Architect.
   5. Accepted mock-up may remain in place.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the project site clearly marked for proper identification.

B. Receive, handle and store materials in conformance with the manufacturers printed instructions.

C. Store products under cover, in manufacturer's unopened packaging until ready for installation.

D. Protect materials from exposure to moisture.

E. Store materials in a dry, warm, ventilated weathertight location.

F. Protect metal fabrications from damage by exposure to weather.

G. Handling: Use a forklift or crane to move material. Do not lift the bundles by the metal bands.
   1. Fork Lift: Spread the forks as far as possible to balance the load. Drive slowly when moving long bundles over uneven surfaces to avoid tipping the load
   2. Crane: Position the canvas sling straps so that the space between the straps is at least 1/3 the length of the bundle. Use sling straps with looped ends running one end of the strap through the loop at the other end to cinch the bundle when lifted. When setting the load on the roof, put wood blocks under it to protect the roof and allow space to remove the sling straps.

3. Roof Placement: Spread the bundles and crates out as much as possible to avoid overloading the roof structure. Place the material directly over major supports such as beams or trusses.
4. Position bundles of tubing parallel to the slope of the roof and block prior to opening to prevent the tubing from rolling down the roof slope when unbundled.

1.09 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. Field Measurements: Verify roof screen dimensions and conditions of the installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating equipment enclosure without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 WARRANTY

A. Framing System: Provide manufacturer's standard written limited warranty stating that the complete framing system shall be warranted against structural failure due to cracking, buckling, bending, tearing or corrosion arising under normal use and environmental conditions for the coverage period applicable.
   1. Products installed on projects located 2 miles or greater from salt or brackish bodies of water shall be warranted for twenty (20) years
   2. Products installed on projects located greater than 1 mile but less than 2 miles from salt or brackish bodies of water will be warranted for five (5) years, except for aluminum, stainless steel or copper Products which will be warranted for twenty (20) years.
   3. Products installed on projects located 1 mile or less from salt or brackish bodies of water will be warranted for three (3) years, except for aluminum, stainless steel or copper Products which will be warranted for twenty (20) years

B. Panel Finish:
   1. Provide written warranty stating that the paint finish applied on all equipment enclosure panels will be warranted against chipping, peeling, cracking, fading, or blistering for the coverage period of twenty (20) years.
   2. Provide warranty signed by the panel manufacturer and paint finish applicator (if separate from manufacturer).

C. The above warranties are in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Design Loads: Comply with Building Code for site location and building height.
   1. Design to resist ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
   2. Design all materials, assembly and attachments to resist snow, wind, suction and uplift loading at any point without damage or permanent set.

B. Structural Design: Prepare structural design calculations for screen framing and attachment to structure including reactions at base supports for verification of roof structure by Architect.

C. All welds to be performed by an AWS certified welder. Valid certification to be provided.

2.02 MANUFACTURERS

A. Basis of Design: Roof Screen Manufacturing

B. Acceptable Manufacturer: RoofScreen Mfg., which is located at: 347 Coral St. ; Santa Cruz, CA 95060; Toll Free Tel: 866-766-3727; Tel: 831-421-9230; Fax: 866-253-0738; Email: request info (info@roofscreen.com); Web: www.roofscreen.com.

C. Requests for substitutions will be considered in accordance with provisions of Section [012500, Substitutions Procedures][016000, Product Requirements and Substitutions].

2.03 MATERIALS

A. Square Base Supports: Weldments fabricated from cold rolled steel conforming to ASTM A 1008, fabricated with pre-punched holes in base plate for fastening to roof structure. After fabrication, apply minimum 2 to 4 mil baked on powder coat primer.
   1. Height 5 inches (127 mm).
   2. Height 9 inches (229 mm).
   3. Height 12 inches (305 mm).

B. Square Base Support Extensions: Fabricated from same material and finish as base supports.
   1. Height 3 inches (76 mm).
   2. Height 4 inches (101 mm).

C. Square Base Cap: Weldments fabricated from AISI Type 304 stainless steel with mill finish, and fabricated to overlap base support and flashing boot a minimum of 2 inches (51 mm). Provide moment resisting adjustable connection to attach framing to base cap.

D. Square Galvanized Roof Flashing: Fabricated from galvanized sheet steel, 24 gauge, conforming to ASTM A 653/A 653M. Provide with [galvanized sheet steel, 24 gauge (ASTM A 653/A 653M)] [lead, 4 psf (ASTM B 749)] base flange that extends a minimum of 4 inches (102 mm) onto the roof surface on all four sides. Riser shall be tapered to allow easy fit over Square Base Supports with minimal gap at top of flashing. Solder all seams for water tightness.

E. Roof Flashing: Refer to Division 07 section that specifies the roof membrane.

F. Framing: Carbon steel structural tubing in manufacturer's standard sizes, conforming to ASTM A 500 with manufacturer's standard galvanized coating conforming to ASTM B 117 salt spray testing. Provide with wall thickness as determined by structural calculations.

G. Connector Fittings: Fabricated from AISI Type 304 stainless steel with mill finish.

H. Steel Z section: Steel sheet conforming to ASTM A 653, Class SS, with a G90 hot-dip galvanized coating.

I. Steel Hat Channel: Steel sheet conforming to ASTM A 653, Class SS, with a G90 hot-dip galvanized coating.

J. Hardware: Bolts, nuts, washers and screws 18-8 stainless steel.

K. Welding Materials: AWS D1.1; type required for materials being welded.

L. Panel:
   1. Profile:
      a. 7.2 Rib Panel.
   2. Base Metal:
      a. Minimum 24 gauge Galvalume steel sheet, AZ50, conforming to ASTM A 792 for painted and unpainted panels.
   3. Finish:
      a. PVDF fluoropolymer, 1 mil, 2 coat, 70 percent.
      b. Siliconized polyester thermoset coating, 0.90 mil minimum dry film thickness.
      c. Color as selected by Architect from manufacturer's standard color range, 20 colors minimum.
      d. Coat reverse side with off-white primer coat.
   4. Panel Fasteners: No. 14 self-tapping sheet metal screw. Color coat heads to match panel color.
   5. Panel Trim: Same material and finish as panel. Configuration as shown on Drawings

2.04 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Fabricate system components so that portions of screen can be dismantled for repairs to equipment being screened and for future roof replacement.

F. Trim and Closures: Fabricated from 24 gauge metal and finished with the manufacturer's standard coating system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine area where work will be installed to verify the installation can be performed in accordance with the Drawings and structural calculation requirements without interference from other equipment or trades.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Do not begin installation until conditions have been properly prepared.

3.02 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.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. Provide for erection loads, and for sufficient temporary bracing to maintain indicated alignment until completion of erection and installation of permanent attachments.

D. Anchor fabrications to structure as indicated.

E. Separate dissimilar metals and use gasketed fasteners, isolation shim, or isolation tape to eliminate possibility of corrosive or electrolytic action between metals.

F. Exercise care when installing components so as not to damage finish surfaces. Touch up as required to repair damaged finishes.

G. Install flashing boots at base supports as required to provide a watertight connection. Install as recommended by the roof membrane manufacturer.

H. Remove all protective masking from material immediately after installation.

3.04 CLEANING AND PROTECTION

A. Remove all protective masking from framing and trim material immediately after installation. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. Maintain in a clean condition during construction.

B. Protect installed products until completion of project.

1. Ensure that finishes and structure of installed systems are not damaged by subsequent construction activities.

2. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations; provide replacement components if repaired finishes are unacceptable to Architect.

C. Prior to Substantial Completion: Remove dust or other foreign matter from component surfaces; clean finishes in accordance with manufacturer's instructions.

D. Replace metal wall panels and framing members that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 8213

SECTION 11 3013
APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment and appliances.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. For all equipment or appliances listed on the Equipment/Appliance Matrix in the drawings, provide catalog data for items identified as "Contractor Furnished".

C. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

1.03 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 EQUIPMENT AND APPLIANCES

A. An Equipment/Appliance Matrix is provided in the drawings. Each item has been identified as either "Owner" or "Contractor" furnished or installed. Manufacturer and Model are also provided. Within the matrix is dimensional information and utility service requirements. Any substitutions need to be submitted for approval per the terms identified in Division 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor built-in equipment in place.

3.03 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.04 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION 11 3013

SECTION 12 2216

DRAPERY TRACK AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum track.

B. Nylon carriers, cords, and accessories.

1.02 REFERENCE STANDARDS

A. WCMA A100.1 - Safety of Corded Window Covering Products; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide track profiles, acceptable load data, finishes available, and electrical characteristics and connection requirements.

C. Shop Drawings: Indicate end track location, width of window opening, location of blocking for anchors, appurtenances and interferences, adjacent construction, operating hardware, and support bracket details.

D. Manufacturer's Installation Instructions: Indicate procedures, perimeter conditions requiring attention.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Drapery Track:
   1. SWFcontract, a division of Springs Window Fashions, LLC; _____: www.swfcontract.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS

A. Tracks: Extruded aluminum, bi-parting operating traverse rods, regular duty channel track.

B. Track Brackets: Formed steel wall type, for recessed installation, with screws and inserts for attachment.

C. Carriers: Nylon roller 3 per foot (10 per m), _____ type.

D. Cord: Braided nylon; continuous loop, free end weighted, complying with WCMA A100.1.

2.03 FINISHES

A. Exposed Surfaces: Black marine grade stainless for exterior condition, (black).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concealed anchors are in correct position.

3.02 INSTALLATION

A. Install drapery tracks in accordance with manufacturer's instructions.

B. Anchor tension pulley to wall.

C. Set cord pulls so that cord pull is 12 inches (300 mm) below window sill in full open position.

3.03 ADJUSTING

A. Adjust drapery hardware for smooth operation.

END OF SECTION 12 2216

SECTION 12 3600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Countertops for manufactured casework.

C. Wall-hung counters and vanity tops.

D. Sinks molded into countertops.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Casework to be removed and reinstalled.

B. Section 02 4100 - Demolition: Selective demolition for removal of casework for reinstallation.

C. Section 05 5000 - Metal Fabrications: Counteretop support brackets.

D. Section 12 3100 - Manufactured Metal Casework.

1.03 REFERENCE STANDARDS

A. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

E. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.

F. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.

G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

H. PS 1 - Structural Plywood; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Product Verification: Verify that the product specified under Part 2 matches and is identical to the product currently installed at the site.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Inventory of Removed Material: Provide inventory of available countertops acquired during selective demolition. Indicate on shop drawings where the removed countertops are to be reinstalled.

D. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

E. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

H. Installation Instructions: Manufacturer's installation instructions and recommendations.

I. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.06 QUALITY ASSURANCE

A. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 FIELD 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.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: See Section 12 3100.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet, Type ___: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
      a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      b. Laminate Core Color: Same as decorative surface.
      c. Finish: Matte or suede, gloss rating of 5 to 20.
      d. Surface Color and Pattern: As indicated on drawings.
   2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch (32 mm) thick; covered with matching laminate.
   3. Back and End Splashes: Same material, same construction.

C. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
   1. For SS-1, SS-2, and SS-3 provide as indicated in the drawings.
   2. Fabricate countertops as indicated below unless noted otherwise in the drawings.
      a. Flat Sheet Thickness: 1-1/4 inch (32 mm), minimum.
      b. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
         1) Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
         2) Finish on Exposed Surfaces: Polished.

c. Other Components Thickness: 3/4 inch (19 mm), minimum.

D. Butcher Block Countertop
1. Basis of Design: Hardwood Lumber Company
2. Thickness: 2"
3. Wood Type: White Oak, Edge grain stained to match WD-3
4. Finish: Pre-finished acrylic urethane with stain

2.02 MATERIALS

A. Wood-Based Components:
1. Wood fabricated from old growth timber is not permitted.
2. Provide sustainably harvested wood, certified or labeled as specified in Section 01 6000 - Product Requirements.
3. Provide wood harvested within a 500 mile (805 km) radius of the project site.
4. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.

B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.

C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.

D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

E. Joint Sealant: Mildew-resistant silicone sealant, white.

2.03 FABRICATION

A. Fabricate in accordance with standards governing fabrication quality that are specified in Section 06 4100.

B. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

C. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches (102 mm), unless otherwise indicated.

PART 3 EXECUTION

3.01 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.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 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.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).

C. Seal joint between back/end splashes and vertical surfaces.
   1. Where applied cove molding is not indicated use specified sealant.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 12 3600

SECTION 12 4940

ROLLER SHADES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes roller shades with manual and motorized shade operators metal shade pockets or recessed housing.

B. Related Sections include the following:
   1. Division 6 Section "Miscellaneous Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
   2. Division 9 Section "Gypsum Board Assemblies" for construction materials adjacent to shade pockets.
   3. Division 9 Section "Acoustical Panel Ceilings" for construction materials adjacent to shade pockets.
   4. Division 16 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
   1. Motorized Shade Operators: Include operating instructions.
   2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show location and extent of roller shades. Include plans, elevations, sections, head/jamb/sill details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.
   1. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
   2. Wiring Diagrams: Power, system, and control wiring. Show connection details for component supplied under this Section for install by others.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
   1. Ceiling suspension system members and attachment to building structure.
   2. Ceiling-mounted or penetrating items including light fixtures; air outlets and inlets; speakers; sprinklers; recessed shades; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
   3. Shade mounting assembly and attachment.
   4. Size and location of access to shade operator, motor, and adjustable components.
   5. Minimum Drawing Scale: 1/4 inch = 1 foot.

D. Samples for Verification:
   1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade cloth indicated.
   2. Shade Material: Not less than 12-inch- square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and

face of material. Also provide full panel mock-up of each specified shadecloth for final approval.

E. Window Treatment Schedule: Include roller shades in schedule using same room designations indicated on Drawings.

F. Product Certificates: For each type of roller shade product, signed by product manufacturer.

G. Product Test Reports: For each type of roller shade product.

H. Qualification Data: For Installer.

I. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
   1. Methods for maintaining roller shades and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
   3. Operating hardware.
   4. Motorized shade operator.

J. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer with 10 years minimum experience, who has completed installation of roller shades similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: Minimum of 25 years experience manufacturing products comparable to those specified in this Section.

C. Source Limitations: Obtain roller shades through one source from a single manufacturer. Manufacturer shall design and fabricate complete shade system, including hardware, shade fabric, and U.L. approved electrical components.

D. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Flame-Resistance Ratings: Passes NFPA 701.

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. Control systems and components shall be approved, as a system, by either Underwriter Laboratories (UL) or Electronic Testing Laboratories (ETL).

F. Shade Cloth Environmental Standard: Material to achieve a "pass" rating for Indoor Air Quality/VOC in compliance with ASTM D 5116 and ASTM D6670 and U.S. Environmental Protection Agency's "Environmental Technology Verification Protocol."

G. Shade Cloth Anti-Microbial Testing Standard: Comply with the following:
   1. ASTM G 22 for ATCC6538 (staphylococcus aureus) and ATCC13388 (Pseudomonas aeroginaosa) indicating minimum 5mm (0197 inches) "No Growth Area."
   2. ASTM G 285 results ATCC9642, ATCC9644, ATCC9348, and ATCC9645 indicating "No Growth."

H. Corded Window Covering Product Standard: Provide roller shades complying with WCMA A 100.1.

1.05 MOCK UPS

A. Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete 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 operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.08 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. Comply with the following:
   1. Rollers Shades Quantity: Before installation begins, provide full-size units equal to 5 percent of amount installed for each size, color, texture, and pattern indicated,
   2. Chain Quantity: Before installation begins, provide additional 5% of the total length of qualified stainless steel chain required on the project, not to exceed the quantity of one 500’ spool.
   3. Mounting Hardware/Brackets Quantity: Before installation begins, provide additional 5% of each type of shade mounting hardware or brackets, but not less than one pair of each type.
   4. Motor Quantity: Before installation begins, provide additional 5% of each motor type used on project, but not less than quantity of one each.
   5. Motor Control Quantity: Before installation begins, provide additional 5% of each motor control component used on project, but not less than quantity of one each.

1.09 WARRANTY

A. Special Warranties:
   1. Manual Operating Components: Provide Manufacturer’s standard warranty stipulating that installation is to remain operational without fault for the warranty period and include all operating parts, including shade cloth, but excluding bead chain. Warranty period to be non-prorated, Limited Lifetime for "Manufacturers' Defect" and "Fit For Use Warranty" from Date of Substantial Completion.
   2. Shade Fabric: Warranty for colorfastness (regardless of color) for 10 years from Date of Substantial Completion.
   3. Shade Motors and Motor Control System Electrical Components: Provide Manufacturer’s standard warranty for shade motors and all other control components stipulating that installation will remain operational without fault for the warranty period and include all operating parts.

B. Warranty Periods: Comply with the following:
   1. Shade Motor Warranty Period: 10 years from Date of Substantial Completion.
   2. Control Components Warranty Period: Two years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROLLER SHADES

A. Basis of Design Products: Subject to compliance with requirements, comply with the following:
   1. Manufacturer: MechoShade Systems, Inc.

B. Shade bands: Construction of shade band includes fabric, hembar and hempocket, and attachment of shade band to roller tube.

C. Shade Band Material, WS-01, 1% Openness, as indicated on the drawings.

D. Shade Band Material, WS-01 Alt, as indicated on the drawings.

E. Shade Band Material, WS-02, 3% Openness, as indicated on the drawings.

F. Shade Band Material, WS-03, 5% Openness, as indicated on the drawings.

G. Shade Band Material, WS-04, Black-out, as indicated on the drawings.

H. Shade Band Material, WS-05, Custom Printed, as indicated on the drawings.

I. Shade Band Material, WS-06 at skylights, 1-3% Openness, as indicated on the drawings.

J. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube for attaching shade material. Provide capacity for one roller shade band per roller, unless otherwise indicated on Drawings.

K. Direction of Roll: Regular, from back of roller.

L. Mounting Brackets: Galvanized or zinc-plated steel.

M. Pocket with Ceiling Slot Opening: Six-sided box units for recessed installation; fabricated from extruded aluminum; with a bottom consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or openable, continuous metal access panel concealing rollers, brackets, and operating hardware and operators within; capacity for one roller shade per pocket, unless otherwise indicated on Drawings. Corner Section: Factory formed and welded. Provide MechoShade 4123 pocket with exposed tile support for acoustical tile ceilings.

N. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

O. Audiovisual Light-Blocking Shades: Designed for eliminating all visible light gaps when shades are fully closed; fabricated from blackout shade band material with pocket and bottom bar extended and formed for light-tight joints among shade components and between shade components and adjacent construction.
   1. Side Channels, Sill Channel or Angle, and Perimeter Seals: Manufacturer's standard design, including sill light seal attached to bottom bar, for eliminating light gaps when shades are closed.
   2. Shade Band Retention System: Manufacturer's standard design for guiding shade band material through range of travel and holding shade band flat with edges of material within side channels.

P. Shade Operation: Manual or motorized as indicated on Drawings. Comply with the following:
   1. Provide for regular and offset drive capacity (chain fall at front or rear of bracket) on all shade drive end brackets.
   2. Provide shade hardware system that allows for removal of shade roller tube from brackets without removing hardware from opening.
   3. Provide shade hardware system that allows for removable regular and / or reverse roll fascia(s) to be mounted continuously across two or more shades without requiring exposed fasteners.
   4. Provide shade hardware system that allows for operation of multiple shade bands by a single chain (Multi-banded shades) operator subject to manufacturer’s design criteria.
   5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when offset a maximum of 6° on each side of the plane perpendicular to the radial line of the curve (12° total offset).
   6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Do not rely on friction fit connections for drive mechanism to shade roller tube.

7. Provide shade hardware constructed of minimum 1/8” thick cadmium plated steel or heavier as required to support 150% of the full weight of each shade.
8. Use only injection molded, Delrin engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics are not acceptable.
9. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets regardless of mounting position (inside or outside mount).
10. Manual Operator: Continuous loop bead chain, clutch, and cord tensioner and bracket lift operator.
    a. Position of Clutch Operator: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
    b. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
    c. Loop Length: Length required to make operation convenient from floor level.
    d. Bead Chain: 90-lbs. test Stainless steel.
    e. Cord Tensioner Mounting: Sill.
    f. Operating Function: Stop and hold shade at any position in ascending or descending travel.
11. Motorized operator: As indicated elsewhere in this Section.

Q. Mounting: Recessed in ceiling pocket mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

2.02 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials. Lifting Mechanism: With permanently lubricated moving parts.

C. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting roller, and operating hardware and for hardware position and shade mounting method indicated.

D. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

E. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

F. Colors of Plastic Components Exposed to View: Matching or coordinating with shade band color, unless otherwise indicated.

2.03 MOTORIZED ROLLER SHADE OPERATORS

A. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and frewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all 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 the building electrical system.

B. Comply with NFPA 70.

C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

D. Electric Motors: UL-approved or -recognized, asynchronous, totally enclosed, insulated, capacitor-start motors, complying with NEMA MG 1, with thermal overload protection, brake,

permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings. Motors shall be part of a UL/ETI approved system.

1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
2. Motor Characteristics: Single phase, 110 V, 60 Hz.
3. Motor Mounting: Within manufacturer's standard roller enclosure.
4. Use motors rated at the same nominal speed for all shades in the same room.
5. Total hanging weight of shade band shall not exceed 80% of the rated lifting capacity of the shade motor and tube assembly.

E. Position of Motor and Electrical Connection: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.

F. Motor Control System:
1. Provide power to each shade motor via individual 3 conductor line voltage circuits connecting each motor to the relay based controllers (IQ/MLC).
2. Control system components provide appropriate (spike and brown out) over-current protection (+/- 10% of line voltage) for each of the four individual motor circuits and shall be rated by UL or ETL as a component of an UL or ETI approved system.
3. Motor control system allows each group of four shade motors to be controlled by each of four local switch ports, with up to fourteen possible “sub-group” combinations via local 3 button wall switches and all at once via a master 3-button switch. System shall allow for overlapping switch combinations from 2 or more switches.
4. Multiple “sub-groups” from different IQ/MLC control components may be combined to form “groups” operated by a single 3-button wall switch.
5. Each shade motor shall be accessible (for control purposes) from up to four local switches and one master switch.
6. Control system shall allow for automatic alignment of shade hembars at 25%, 50% and 75% of opening heights, or up to three user defined intermediate stopping positions in addition to all up / all down positions regardless of shade height. Control system shall allow shades to be stopped at any point in the opening height; however, shade hembars may not be in alignment at these non-defined positions.
7. Control system shall have two standard operating modes: Normal Mode allowing the shades to be stopped anywhere in the opening height and Uniform Mode allowing the shades to only be stopped at the predefined intermediate stop positions. Both modes shall allow for all up/all down positioning.
8. Control system components shall allow for interface with low voltage Audio Visual system components via a dry contact terminal block.
9. Control system components shall allow for interface with external analog input control devices such as solar activated controllers, wind activated controllers, 24-hour timers, etc. via a dry contact terminal block.
10. Reconfiguration of switchable groups shall not require rewiring of the hardwired line voltage motor power supply wiring or the low voltage control wiring.

G. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following devices for remote-control activation of shades:
1. Individual/Group Control Stations: Momentary-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions for individual and group control.
   a. Color: White.
   b. Product: Subject to compliance with requirements, provide "Decora Plus" by Leviton Manufacturing Co., Inc. White .
2. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features. Provide unit isolated from voltage spikes and surges.

H. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

I. Operating Function: Stop and hold shade at any position, and at five predetermined positions including open, closed, and three user-programmed positions.

J. Operating Features: Include the following:
   1. Group switching with integrated switch control; single face plate for multiple switch cut-outs.
   2. Capable of interface with audiovisual control system.
   3. Back-up gear and crank operator for manual operation during power failures with detachable handle, length required to make operation convenient from floor level.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Connections: Connect motorized operators to building electrical system.

3.03 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.04 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.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. Refer to Division 1 Section " Demonstration and Training."

END OF SECTION 12 4940

SECTION 13 4813

SOUND CONTROL UNDERLAYMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, materials, tools and equipment for the installation of the sound control floor underlayment where shown on the contract drawings.

1.02 SYSTEM DESCRIPTION

A. The sound control underlayment is applied continuously as part of the floor system to control both impact/structureborne and airborne noise transmission through the floor into the space below.

B. The perimeter of the floor areas where the underlayment is used shall have a continuous resilient joint to isolate structureborne noise from all adjacent non-isolated floors, walls, columns or other structure.

1.03 QUALITY ASSURANCE

A. The sound control underlayment shall be produced by a manufacturer having a minimum of five years' experience in furnishing similar noise control underlayment for floor systems.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Basis of Design: Kinetics Nois Control, Model 'SR Floorboard'; Dublin,Ohio (800) 959-1229.

B. The sound rated floor underlayment shall consist of a 1" thick composite consisting of a rigid phenolic-treated honeycomb core molded between two layers of high-density glass fiber. The isolation board shall be capable of withstanding up to 1,000 lbs./sq. ft. loading with a maximum of 0.15" of additional deflection.

C. The perimeter isolation material shall be 3/8" thick Model SRP perimeter board as manufactured by Kinetics Noise Control.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The correct installation of the sound control underlayment and the resilient perimeter isolation material is critical in order to achieve the desired noise reduction. Any rigid connections such as screws, staples or pipe penetrations, which physically connect the sound rated floor assembly to the structural floor below or to adjacent walls, will reduce the noise control performance of the system. All sound rated floor systems must be installed per the manufacturer's installation guidelines.

END OF SECTION 13 4813

SECTION 21 1313

WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 REFERENCE STANDARDS

A. California Building Code (CBC), 2016 Edition

B. California Fire Code (CFC), 2016 Edition

C. NFPA 13, *Standard for Installation of Sprinkler System,* 2016 Edition with California Amendments

D. NFPA 25, *Inspection, Testing, and Maintenance of Water-Based Fire Protection System,* California Edition 2013

1.03 SUMMARY

A. Section Includes:
   1. Pipes, fittings, and specialties.
   2. Specialty valves.
   3. Sprinklers.
   4. Alarm devices.
   5. Pressure gages.

B. Related Requirements:
   1. Section 211316 "Dry-Pipe Sprinkler Systems" for pre-action system requirements.
   2. Section 212200 "Clean Agent Fire Extinguishing System" for Clean Agent System.

1.04 SYSTEM DESCRIPTION

A. Modify existing automatic wet-pipe fire sprinkler system to provide complete fire protection coverage throughout the renovated space with the exception of the Data Center, A1029, which will be provided with a clean agent system and a double-interlock pre-action system. Refer to Section 211316 and Section 212200.

B. Replace and provide all sprinkler drops in suspended ceiling with flexible hose fitting.

C. Reuse existing components that are in working condition and meet the requirements of NFPA 13 and NFPA 25 California Edition.

D. Provide upgrades in accordance with the Tokyo Marine Property Risk Control Visit on 22 March, 2018

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.
   1. Include plans in accordance with Section 23.1 of NFPA 13 and City of San Diego Requirements

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer. Refer to Quality Assurance for requirements.

B. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13 and city of San Diego requirements, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Welding certificates.

D. Field Test Reports:
   1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
   2. Fire-hydrant flow test report.

E. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.08 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and 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 used on Project.

1.09 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Shall be licensed C-16 Fire Protection Contractor.
   2. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.10 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Architect, Construction Manager, and Owner no fewer than three (3) days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Architect's, Construction Manager's, or Owner's written permission.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

C. Delegated Design:
   1. Contractor shall be responsible for obtaining current hydrant flow test data.
   2. Sprinkler system design shall be approved by authorities having jurisdiction.
      a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
      b. Sprinkler Occupancy Hazard Classifications:

1) Building Service Areas (Mechanical Equipment and Electrical Rooms): Ordinary Hazard, Group 1
2) General Storage Areas: Ordinary Hazard, Group 1
3) Food Court Area: Ordinary Hazard, Group 1
4) Office and Public Areas: Light Hazard

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
4. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft. (20.9 sq. m)
   b. Storage Areas: 130 sq. ft. (12.1 sq. m)
   c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m)
   d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m)
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

D. Total Combined Hose-Stream Demand requirement: According to NFPA 13.

E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7

2.02 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black**-**Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.

C. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M thinwall with plain ends and wall thickness less than Schedule 10.

D. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

E. Uncoated**-**Steel Couplings: ASTM A 865/A 865M, threaded.

F. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

G. Malleable- or Ductile-Iron Unions: UL 860.

H. Cast-Iron Flanges: ASME 16.1, Class 125.

I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
   1. Pipe-Flange Gasket Materials: ASME B16.21, EPDM rubber gasket.
      a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
      b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
   2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

J. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
   1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

K. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Pressure Rating: 175-psig (1200-kPa) minimum.
   2. Painted or Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
   3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

L. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.03 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:
   1. Standard-Pressure Piping Specialty Valves: 175-psig (1200-kPa) minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:
   1. Standard: UL 193.
   2. Design: For horizontal or vertical installation.
   3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
   4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
   5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
   6. 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.

2.04 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
   1. Standard: UL 213.
   2. Pressure Rating: 175-psig (1200-kPa) minimum.
   3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   4. Type: Mechanical-tee and -cross fittings.
   5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
   1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
   2. Pressure Rating: 175-psig (1200-kPa) minimum.
   3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
   4. Size: Same as connected piping.
   5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:
   1. Standard: UL 199.
   2. Pressure Rating: 175 psig (1200 kPa).
   3. Body Material: Brass.
   4. Size: Same as connected piping.
   5. Inlet: Threaded.
   6. Drain Outlet: Threaded and capped.
   7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:
   1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
   2. Pressure Rating: 175-psig (1200-kPa) minimum.
   3. Body Material: Cast- or ductile-iron housing with sight glass.
   4. Size: Same as connected piping.

5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
1. Standard: UL 1474.
2. Pressure Rating: 250-psig (1725-kPa) minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:
1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175-psig (1200-kPa) minimum.
4. Size: Same as connected piping, for sprinkler.

2.05 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Automatic Sprinklers: 175-psig (1200-kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with minimum Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes: Chrome plate or painted as required by Architect to match ceiling.

E. Special Coatings: Wax or corrosion-resistant paint in areas subject to corrosion.

F. 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, two piece, with 1-inch (25-mm) vertical adjustment
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

2.06 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:
1. Standard: UL 464.
2. Type: Vibrating, metal alarm bell.
3. Size: 8-inch (200-mm) minimum diameter.
4. Finish: Red-enamel factory finish, suitable for outdoor use.
5. 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. Water-Flow Indicators:
1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: 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 signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig (1725 kPa).
6. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:
1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. 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.

2.07 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

C. Pressure Gage Range: 0- to 250-psig (0- to 1725-kPa) minimum.

D. Label: Include "WATER" label on dial face.

PART 3 EXECUTION

3.01 PREPARATION

A. Obtain or Perform fire-hydrant flow test according to NFPA 13 and NFPA 291 or City of San Diego DS-160. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 SERVICE-ENTRANCE PIPING

A. Install shutoff valve, backflow preventer (*replace existing backflow preventer if not in accordance with Information Bulletin 113)*, pressure gage, drain, and other accessories indicated at connection to water-service piping. If Backflow preventer requires replacement, comply with City of San Diego Information Bulletin 113.

B. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.03 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas.

M. 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 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

N. Fill sprinkler system piping with water.

O. Install sleeves for piping penetrations of walls, ceilings, and floors as required by NFPA 13.

P. Install sleeve seals for piping penetrations of concrete walls and slabs as required by NFPA 13.

3.04 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

3.05 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources where applicable for project.

D. Specialty Valves:
   1. Install valves in vertical position for proper direction of flow, in main supply to system.
   2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

3.06 SPRINKLER INSTALLATION

A. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid, center of tile unless instructed otherwise by Architect/Engineer.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.07 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with Owner representative present:
   1. Leak Test: After installation, charge systems 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire-alarm tests. Operate as required.
   6. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with NFPA 13.

3.09 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller shall be one of the following:
   1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and greater, shall be one of the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
   4. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   5. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings (Office areas): Recessed sprinklers
   3. Rooms with Suspended Ceilings in Public Areas (Lobby, Corridors): Concealed sprinklers
   4. Rooms with Hard-lid Ceilings: Concealed sprinklers
   5. Wall Mounting: Sidewall sprinklers.
   6. Spaces Subject to Freezing: Pendent, dry sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   4. Residential Sprinklers: Dull chrome.
   5. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 1313

SECTION 21 1316

PRE-ACTION FIRE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 REFERENCE STANDARDS

A. California Building Code (CBC), 2016 Edition

B. California Fire Code (CFC), 2016 Edition

C. NFPA 13, *Standard for Installation of Sprinkler System,* 2016 Edition with California Amendments

D. NFPA 25, *Inspection, Testing, and Maintenance of Water-Based Fire Protection System,* California Edition 2013

1.03 SUMMARY

A. Section Includes:
   1. Pipes, fittings, and specialties.
   2. Specialty valves.
   3. Sprinkler specialty pipe fittings.
   4. Sprinklers.
   5. Alarm devices.
   6. Manual control stations.
   7. Control panels.
   8. Pressure gages.

B. Related Requirements:
   1. Section 211316 "Dry-Pipe Sprinkler Systems" for pre-action system requirements.
   2. Section 212200 "Clean Agent Fire Extinguishing System" for Clean Agent System.

1.04 SYSTEM DESCRIPTION

A. Provide double-interlock pre-action system in Data Center, A1029.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For pre-pipe sprinkler systems.
   1. Include plans in accordance with Section 23.1 of NFPA 13 and City of San Diego Requirements
   2. Include diagrams for power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer. Refer to Quality Assurance for requirements.

B. Design Data:
   1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13 and City of San Diego requirements, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Fire-hydrant flow test report in accordance with City of San Diego DS

D. Field Test Reports:
   1. Fire-hydrant flow test report.

2. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

E. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.08 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and 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 used on Project.

1.09 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Shall be licensed C-16 Fire Protection Contractor.
   2. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.10 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Architect, Construction Manager, and Owner no fewer than three (3) days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Architect's, Construction Manager's, or Owner's written permission.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTIONS

A. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system (automatic sprinkler heads), located in same area as sprinklers, opens deluge valve, permitting water to flow into sprinkler piping. A closed solenoid valve in the sprinkler piping is opened by another fire-detection device (smoke detection, provided by others); water will then discharge from opened sprinklers.

2.02 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

C. Delegated Design:
   1. Contractor shall be responsible for obtaining current hydrant flow test data.
   2. Sprinkler system design shall be approved by authorities having jurisdiction.
      a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
      b. Sprinkler Occupancy Hazard Classifications:

1) Building Service Areas (Mechanical Equipment and Electrical Rooms): Ordinary Hazard, Group 1

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
4. Maximum Protection Area per Sprinkler:
   a. 130 sq. ft. (12.1 sq. m)

D. Total Combined Hose-Stream Demand requirement: According to NFPA 13.

E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.03 STEEL PIPE AND FITTINGS

A. Schedule 40, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.

H. Grooved-Joint, Steel-Pipe Appurtenances:
1. Pressure Rating: 175-psig (1200-kPa) minimum.
2. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.04 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:
1. Standard-Pressure Piping Specialty Valves: 175-psig (1200-kPa) minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Deluge Valves:
1. Standard: UL 260.
2. Design: Hydraulically operated, differential-pressure type.
3. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.
4. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
5. Air-Pressure Maintenance Device:
   a. Standard: UL 260.

b. Type: Automatic device to maintain minimum air pressure in piping.
c. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) outlet pressure.

6. Air Compressor:
7. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
8. Motor Horsepower: Fractional.
9. Power: 120-V ac, 60 Hz, single phase.
10. 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

G. Automatic (Ball Drip) Drain Valves:
1. Standard: UL 1726.
2. Pressure Rating: 175-psig (1200-kPa) minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4 (DN 20).
5. End Connections: Threaded.

2.05 SPRINKLER PIPING SPECIALTIES

A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:
1. Standard: UL 213.
2. Pressure Rating: 175-psig (1200-kPa) minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-tee and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig (1200-kPa) minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

D. Branch Line Testers:
1. Standard: UL 199.
2. Pressure Rating: 175-psig (1200-kPa) minimum.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig (1200-kPa) minimum
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:
1. Standard: UL 1474.

2. Pressure Rating: 250-psig (1725-kPa) minimum
3. Body Material: Steel pipe with EPDM O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

G. Flexible Sprinkler Hose Fittings:
1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175-psig (1200-kPa) minimum
4. Size: Same as connected piping, for sprinkler.

2.06 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Automatic Sprinklers: 175-psig (1200-kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199
2. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes: Chrome plated

E. 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, two piece, with 1-inch (25-mm) vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

F. Sprinkler Guards:
1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

2.07 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Pressure Switches:
1. Standard: UL 346.
2. Type: Electrically supervised water-flow switch with retard feature.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design Operation: Rising pressure signals water flow.

C. Valve Supervisory Switches:
1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. 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

2.08 MANUAL CONTROL STATIONS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve.

B. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.09 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
   1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
   2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
   3. 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

B. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

D. Panels Components:
   1. Power supply.
   2. Battery charger.
   3. Standby batteries.
   4. Field-wiring terminal strip.
   5. Electrically supervised solenoid valves and polarized fire-alarm bell.
   6. Lamp test facility.
   7. Single-pole, double-throw auxiliary alarm contacts.
   8. Rectifier.

2.10 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

C. Pressure Gage Range: 0- to 250-psig (0- to 1725-kPa) minimum

D. Label: Include "WATER" or "AIR/WATER" label on dial face.

E. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 EXECUTION

3.01 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
   2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.

K. Connect compressed-air supply to dry-pipe sprinkler piping.

L. Connect air compressor to the following piping and wiring:
   1. Pressure gages and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including low-pressure alarm.

M. Install alarm devices in piping systems.

N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

O. 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 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

P. Drain dry-pipe sprinkler piping.

Q. Pressurize and check dry-pipe sprinkler system piping and air compressors.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

3.03 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. Install valves in vertical position for proper direction of flow, in main supply to system.
   2. Install valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
      a. Install air compressor and compressed-air-supply piping.
      b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
      c. Install compressed-air-supply piping from building's compressed-air piping system.

3.05 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.06 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.07 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with Owner representative present:
   1. Leak Test: After installation, charge systems 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Start and run air compressors.
   6. Coordinate with fire-alarm tests. Operate as required.
   7. Coordinate with fire-pump tests. Operate as required.
   8. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.08 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.09 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.10 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Standard-pressure, dry-pipe sprinkler system, shall be one of the following:
   1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
   2. Schedule 40, galvanized-steel pipe with rolled-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers
   2. Rooms with Suspended Ceiling: Concealed sprinklers
   3. Wall Mounting: Dry sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   3. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 1316

SECTION 21 2200

CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 REFERENCE STANDARDS

A. California Building Code (CBC), 2016 Edition

B. California Fire Code (CFC), 2016 Edition

C. NFPA 72, *National Fire Alarm Code,* 2016 Edition with California Amendments

D. NFPA 75, *Protection of Electronic Computer/Data Processing Equipment,* 2016 Edition

E. NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems,* 2016 Edition with California Amendments

1.03 SUMMARY

A. Section Includes:
   1. Clean-agent systems.
   2. Pipe and fittings.
   3. Valves.
   4. Extinguishing-agent containers.
   5. Fire-extinguishing clean agent.
   6. Discharge nozzles.
   7. Manifold and orifice unions.
   8. Fire control panels.
   9. Detection devices.
   10. Manual stations.
   11. Switches.
   12. Alarm devices.

B. Related Requirements:
   1. Section 211313 “Wet-Pipe Sprinkler Systems” for wet-pipe sprinkler system requirements.
   2. Section 211316 "Dry-Pipe Sprinkler Systems" for pre-action system requirements.

1.04 SYSTEM DESCRIPTION

A. Provide Clean Agent system in Data Center, A1029.

1.05 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. EPO: Emergency Power Off.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer or NICET Level III Special Hazards Designer.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include design calculations.
   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: For power, signal, and control wiring.
5. Indicate compliance with performance requirements and design criteria, including analysis data.
6. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.
7. Indicate the Following on Reflected Ceiling Plans:
    a. Ceiling penetrations and ceiling-mounted items.
    b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.
    c. Method of attaching hangers to building structure.
    d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
8. Indicate the Following on Occupied Work Area Plans:
    a. Controls and alarms.
    b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.
    c. Equipment and furnishings.
9. Indicate the Following on Access Floor Space Plans:
    a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
    b. Method of supporting piping.
10. Indicate the Following on Ceiling Plans:
    a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
    b. Method of supporting piping.
    c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.

1.07 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
    1. Domestic water piping.
    2. Items Penetrating Finished Ceiling Include the Following:
        a. Lighting fixtures.
        b. Air outlets and inlets.

B. Design Data:
    1. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.

C. Seismic Qualification Data: Certificates, for extinguishing-agent containers and control panels from manufacturer.
    1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    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. Field quality-control reports.

1.08 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.

1.09 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. Deliver extra materials to Owner.
   1. Detection Devices: Not less than 20 percent of amount of each type installed.
   2. Container Valves: Not less than 10 percent of amount of each size and type installed.
   3. Nozzles: Not less than 20 percent of amount of each type installed.
   4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.10 QUALITY ASSURANCE

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.

B. FM Global Compliance: Provide components that are FM Approved and that are listed in FM Global's "Approval Guide."

C. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

PART 2 PRODUCTS

2.01 CLEAN-AGENT SYSTEMS

A. Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling, and below the raised floor.

B. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.

C. Performance Requirements: Discharge HFC 227ea within 10 seconds and maintain 8 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.
   1. System Capabilities: Minimum 620-psig (4278-kPa) calculated working pressure and 360-psig (2484-kPa) initial charging pressure.

D. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.

E. Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.

F. System Operating Sequence:
   1. Actuating First Detector: Visual indication on annunciator panel. Energize audible and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire-alarm system.
   2. Actuating Second Detector: Visual indication on annunciator panel. Energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing-agent discharge for 30 seconds, and discharge extinguishing agent. On agent discharge, release preaction valve to allow water to fill sprinkler system.
   3. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.

G. System Operating Sequence: System shall be cross-zoned, air-sampling detectors and photoelectric detectors reporting to a fully programmable microprocessor-based control panel programmed to operate as follows:
   1. If one photoelectric detector and air-sampling detector reaches the third detection level (Fire 1), agent discharge will be initiated as described for the third detection level (Fire 1) below.
   2. Air-Sampling System:

a. First Detection Level (Alert): Mild audible and visual indication on annunciator panel. Strobe lights flash slowly in the protected area.
b. Second Detection Level (Action): Strong audible and visual indication on annunciator panel. Strobe lights flash rapidly in the protected area.
c. Third Detection Level (Fire 1): Strong audible and visual indication on annunciator panel. Energize horn(s), bell(s), and strobe light(s) in the protected area and outside entry doors. Shut down air-conditioning and ventilating systems serving the protected area, and close doors in the protected area. Send signal to fire-alarm system, initiate 30-second time delay for extinguishing-agent discharge, and discharge extinguishing agent. At agent discharge, terminate power to equipment in the protected area, and release preaction valve to allow water flow to sprinkler system.
d. Fourth Detection Level (Fire 2): Same as Fire 1.

H. Manual stations shall immediately discharge extinguishing agent when activated.

I. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.

J. EPO: Will terminate power to protected equipment immediately on actuation.

K. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.

L. Power Transfer Switch: Transfer from normal to stand-by power source.

M. Seismic Performance: Fire-suppression piping and containers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
1. 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 and the unit will be fully operational after the seismic event"

2.02 PIPE AND FITTINGS

A. See "HFC 227ea Agent Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

C. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106/A 106M, Grade A; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.
1. Threaded Fittings:
a. Malleable-Iron Fittings: ASME B16.3, Class 300.
b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.
c. Fittings Working Pressure: 620 psig (4278 kPa) minimum.
d. Flanged Joints: Class 300 minimum.
2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
3. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

D. 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 (3.2-mm) maximum thickness unless thickness or specific material is indicated.

E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.03 VALVES

A. General Valve Requirements:
   1. UL listed or FM Approved for use in fire-protection systems.
   2. Compatible with type of clean agent used.

B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.

D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.04 EXTINGUISHING-AGENT CONTAINERS

A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
   1. Finish: Manufacturer's standard color or RED, enamel or epoxy paint.
   2. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
   3. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
   4. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

2.05 FIRE-EXTINGUISHING CLEAN AGENT

A. HFC 227ea Clean Agent: Heptafluoropropane.

2.06 DISCHARGE NOZZLES

A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application.

B. Material: Corrosion-resistant metal.

C. Stamped with orifice size and type.

2.07 MANIFOLD AND ORIFICE UNIONS

A. Description: NRTL-listed device with minimum 2175-psig (15-MPa) pressure rating, to control flow and reduce pressure of IG-541 gas in piping.
   1. NPS 2 (DN 50) and Smaller: Piping assembly with orifice, sized for system design requirements.
   2. NPS 2-1/2 (DN 65) and Larger: Piping assembly with nipple, sized for system design requirements.

2.08 FIRE CONTROL PANELS

A. Description: FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.

B. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.

C. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
   1. Mounting: Recessed flush with surface or Surface.

D. Supervised Circuits: Separate circuits for each independent hazard area.

1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
2. Manual pull-station circuit.
3. Alarm circuit.
4. Release circuit.
5. Abort circuit.
6. EPO circuit.

E. Control-Panel Features:
1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
2. Automatic switchover to standby power at loss of primary power.
3. Storage container, low-pressure indicator.
4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.

F. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.

G. Standby Power: Sealed lead calcium or Sealed, valve-regulated, recombinant lead acid, or Vented, wet-cell pocket, plate nickel cadmium batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.

2.09 DETECTION DEVICES

A. General Requirements for Detection Devices:
1. Comply with NFPA 2001, NFPA 72, and UL 268.
2. 24-V dc, nominal.

B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

D. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.
1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.
3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05-inch wg (12.5 Pa) at all sampling ports.
4. Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.

E. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

2.10 MANUAL STATIONS

A. General Description: Surface FM Approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.

C. Abort Switch: "ABORT" caption, momentary contact, with green finish.

D. EPO Switch: "EPO" caption, with yellow finish.

2.11 SWITCHES

A. Description: FM Approved or NRTL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
   1. Low-Agent Pressure Switches: Pneumatic operation.
   2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
   3. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.12 ALARM DEVICES

A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" or Section 284621.13 "Conventional Fire-Alarm Systems" for alarm and monitoring devices.

B. Bells: Minimum 6-inch (150-mm) diameter.

C. Horns: 90 to 94 dBA.

D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 HFC 227ea AGENT PIPING APPLICATIONS

A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.

B. NPS 2 (DN 50) and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.

C. NPS 2-1/2 (DN 65) and Larger: Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

3.03 CLEAN-AGENT PIPING INSTALLATION

A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.

B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.

C. Install extinguishing-agent containers anchored to substrate.

D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."
   1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.
   2. Support piping using supports and methods according to NFPA 13.
   3. Install seismic restraints for extinguishing-agent containers and piping systems.
   4. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

3.04 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Section 284621.11 "Addressable Fire-Alarm Systems" or Section 284621.13 "Conventional Fire-Alarm Systems."

3.05 IDENTIFICATION

A. Identify system components and equipment. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.

C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.

D. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:
   1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
   3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
   5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.07 CLEANING

A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

3.08 SYSTEM FILLING

A. Preparation:
   1. Verify that piping system installation is completed and cleaned.
   2. Check for complete enclosure integrity.
   3. Check operation of ventilation and exhaust systems.

B. Filling Procedures:

1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.
2. Install filled extinguishing-agent containers.
3. Energize circuits.
4. Adjust operating controls.

3.09 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems.

END OF SECTION 21 2200

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 apply to this Section.

1.02 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.

1.03 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.

1.04 SUBMITTALS

A. Product Data: Submit brochures for the following materials to the Architect in accordance with the provisions of Division 1 of these specifications.
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

1.05 QUALITY ASSURANCE

A. Codes and Standards:
   1. All governing Codes, Ordinances and Agencies, in accordance with the provisions of Division 1 of these specifications.

B. Warranty: In accordance with the provisions of Division 1 of these specifications.

1.06 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.

1.07 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 PLUMBING SPECIALTIES Section 221119.

PART 2 PRODUCTS

2.01 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.

2.02 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.

2.03 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: ASME B18.2.1, carbon steel, 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, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

2.04 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. JCM Industries.
   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: PVC 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, 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., or equal.

D. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
   1. Manufacturers:
      a. NIBCO INC., or equal.

2.05 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: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   2. Manufacturers:
      a. Epco Sales, Inc.
      b. Watts Industries, Inc.; Water Products Div.
      c. Zurn Industries, Inc.; Wilkins Div.

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. Epco Sales, Inc.
      b. Watts Industries, Inc.; Water Products Div.
      c. Elkhart or CTS, Copper by Steel Flange

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. Pipeline Seal and Insulator, Inc.
   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. Southern Specialties.

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. Precision Plumbing Products, Inc.
      b. Sioux Chief Manufacturing Co., Inc.
      c. Victaulic Co. of America.

2.06 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, 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.

2.07 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. Polished chrome-plated with set screw.

PART 3 EXECUTION

3.01 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 closely as practical to routing indicated on plans.

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: 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, cast-brass type with polished chrome-plated finish.
      e. Bare Piping in Unfinished Service 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. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions if required for fire-proofing, 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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/2 inch 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.
      b. 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 Section "Sheet Metal Flashing and Trim" for flashing.
   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.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for manufacturer recommended annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   3. Install HDPE pipe for sleeves for all pipe sizes.
   4. 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 HDPE with compatible links for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for manufacturer recommended 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 approved firestop materials, equal to Hilti.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 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. 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.

F. 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.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple or flange fittings to connect piping materials of dissimilar metals.

3.04 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. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.05 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to 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.

END OF SECTION 22 0500

SECTION 22 0516

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

1.01 PRODUCTS

A. PACKLESS EXPANSION JOINTS:

1. Rubber Union Connector Expansion Joints:
   a. Twin reinforced-rubber spheres with external restraining cables.
   b. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
2. Flexible-Hose Packless Expansion Joints:
   a. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
   b. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
   c. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.
   d. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with welded end connections.
   e. To prevent movement of sanitary piping crossing building expiation joints the use of MetraFlex DWV NO-HUB PoopLoop with 8” of movement shall be required.

B. ALIGNMENT GUIDES AND ANCHORS:

1. Alignment Guides: Steel, factory fabricated.
2. Install expansion joints of sizes matching sizes of piping in which they are installed.
3. Anchor Materials:
   a. Steel shapes, plates, bolts, nuts, and washers.
   b. Wedge-type mechanical anchor fasteners.

END OF SECTION 22 0516

SECTION 22 0517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

1.01 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or ductile iron, with plain ends and integral waterstop collar.

B. Steel Pipe Sleeves: Anticorrosion coated, with plain ends and integral waterstop collar.

C. Galvanized-Steel Sheet Pipe Sleeves: Round tube closed with welded longitudinal joint.

D. PVC Pipe Sleeves: Schedule 40.

E. Molded-PVC Sleeves: With nailing flange.

F. Molded-PE or -PP Sleeves: Removable, with nailing flange.

1.02 STACK SLEEVE FITTINGS

A. Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral cast flashing flange, with underdeck clamp.

1.03 SLEEVE-SEAL SYSTEMS

A. Field-assembled, modular sealing-element unit for filling annular space between piping and sleeve.

B. Sealing Elements: EPDM rubber.

C. Pressure Plates: Stainless steel.

D. Connecting Bolts and Nuts: Stainless steel.

1.04 SLEEVE-SEAL FITTINGS

A. Manufactured, sleeve-type, plastic or rubber waterstop assembly made for imbedding in concrete slab or wall.

1.05 GROUT

A. Nonshrink, factory packaged.

1.06 SILICONE SEALANTS

A. Silicone Sealant: Type S, Grade NS, Class 25, Use NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.

B. Silicone Sealant: Type S, Grade P, Class 25, Use NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1.07 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Exterior Concrete Walls above Grade:

B. Piping Smaller Than NPS 6 (DN 150) Sleeve-seal fittings.

C. Piping [NPS 6 (DN 150)] Sleeve-seal fittings

D. Exterior Concrete Walls below Grade:

E. Piping Smaller Than 0NPS 6 (DN 150) Steel pipe sleeves with sleeve-seal system

F. Piping NPS 6 (DN 150) Same as above.

G. Concrete Slabs-on-Grade:

H. Piping Smaller Than NPS 6 (DN 150) Steel pipe sleeves with sleeve-seal system

I. Piping NPS 6 (DN 150) Same as above.

J. Concrete Slabs above Grade:
K. Piping Smaller Than NPS 6 (DN 150) Fire rated Sleeve-seal assembly
L. Piping NPS 6 (DN 150) Same as above.
M. Interior Partitions:
N. Piping Smaller Than NPS 6 (DN 150) Fire rated Sleeve-seal assembly
O. Piping NPS 6 (DN 150) Same as above.

END OF SECTION 22 0517

SECTION 22 0518
ESCUTCHEONS FOR PLUMBING PIPING

1.01 SUMMARY

A. Section includes:
   1. Escutcheons.
   2. Floor plates.

1.02 PRODUCTS

A. Escutcheons for New Piping:
   1. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
   2. Chrome-Plated Piping: one-piece cast brass with polished, chrome-plated finish.
   3. Insulated Piping: One-piece cast brass with polished brass finish
   4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish
   5. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
   6. Bare Piping in Unfinished Service Spaces: One-piece cast brass with rough-brass finish

B. Floor Plates: Split-plate, stamped steel with concealed hinge.

1.03 INSTALLATION

C. Escutcheons for New Piping:
   1. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
   2. Chrome-Plated Piping: one-piece cast brass with polished, chrome-plated finish.
   3. Insulated Piping: One-piece cast brass with polished brass finish
   4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish
   5. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
   6. Bare Piping in Unfinished Service Spaces: One-piece cast brass with rough-brass finish

D. Floor Plates: Split-plate, stamped steel with concealed hinge.

END OF SECTION 22 0518

SECTION 22 0523

GENERAL DUTY VALVES FOR PLUMBING AND PIPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. GENERAL-DUTY VALVES FOR PLUMBING PIPING consists of furnishing transportation, labor, materials, and equipment to furnish and install the following general-duty valves:
   1. Ball valves.
   2. Check valves.
   3. Gate valves.

1.02 RELATED WORK

A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 of these specifications.

B. COMMON WORK RESULTS FOR PLUMBING - Section 220500

C. IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT - Section 220553

D. DOMESTIC WATER PIPING - Section 221116

1.03 REFERENCES

A. American Society of Mechanical Engineers (ASME)

B. American Water Works Association (AWWA)

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.05 QUALITY ASSURANCE

A. Codes and Standards:
   1. All governing Codes, Ordinance and Agencies, in accordance with the provisions of Division 01 of these specifications.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valved dimensions and design criteria.
   2. ASME B31.9 for building service piping valves.

C. NSF Compliance: NSF 61-G for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set gate valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 PRODUCTS

2.01 VALVES, GENERAL

A. Refer to Valve Applications Article in this Section for applications of valves.

B. Bronze valves shall be made with dezincification-resistant materials.
   1. Valves for potable water must comply with California Lead Free Law.
   2. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤ 0.25%. Source: California Health Safety Code (116875).
   3. All valves used in potable water systems must be 3rd party certified.

C. Bronze Valves: NPS 2 and smaller with threaded ends, soldered or pressure, unless otherwise indicated.

D. Ferrous Valves: NPS 2-1/2" and larger with flanged ends, soldered or pressure, unless otherwise indicated.

E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

2.02 BRONZE BALL VALVES

A. 2 in. and smaller: Two-Piece, Bronze Ball Valves, Dezincification resistant lead free bronze body with full-port, chromium plated steel ball and trim; TFE seats; and 600-psig minimum cold working pressure rating and blowout-proof stem, MSS SP-110, NSF-61-G. Provide with locking lever handle feature where used in recycled water piping.
   1. Manufacturers:
      a. Conbraco Industries, Inc.; Apollo Division: Model 77CLF-100 Series
      b. NIBCO INC., Model T-685-80-66-LF

B. 2 ½ in. and larger: Two-Piece, Bronze Ball Valves: Dezincification resistant lead free bronze body with standard-port, chromium-plated steel ball and trim; RPTFE seats; and 600-psig minimum cold working pressure rating and blowout-proof stem. Provide with locking lever handle feature where used in recycled water piping.
   1. Manufacturers:
      a. Conbraco Industries, Inc.; Apollo Division: Model 70LF-100 Series

2.03 BRONZE CHECK VALVES

A. 3 in. and smaller: Y-pattern, Class 125, Bronze, Horizontal Swing Check Valves: Dezincification resistant lead free bronze body with renewable nonmetallic disc and bronze seat, MSS SP-80.
   1. Manufacturers:
      a. Conbraco Industries, Inc.; Apollo Division: Model 61Y-LF Series
      b. NIBCO INC., Model T-413-Y-LF

2.04 SPRING-LOADED CHECK VALVES

A. In-Line Check Valve: 2 in. and smaller; Lead-Free Bronze body, threaded, stainless steel spring, 400 psi CWP.
   1. Manufacturers:
      a. NIBCO, INC., Model T-413-Y-LF.
      b. Conbraco Industries, Inc., Apollo Division: Model CVB-61-100-LF Series.

B. Dual Check Valve: 2 in. and smaller; Lead-Free composite body, corrosion resistant internal parts, two (2) independently operated in-line spring-loaded modular checks.
   1. Manufacturers:
      a. Wilkins Model 705-XL.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

D. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

E. Examine threads on valve and mating pipe for form and cleanliness.

F. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

G. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, or gate valves.
   2. Throttling Service: Ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:
   1. Ball Valves: NPS 2 in. and Smaller; Bronze Lead-Free Ball Valves, Two-piece, Full-Port, 600-psig CWP rating with chromium plated steel ball. NPS 2 ½ in and larger; Bronze Lead-Free Ball Valves, Two-piece, standard-port, 600 psi CWP rating with chromium-plated ball.
   2. Swing Check Valves, NPS 3 and Smaller: Lead-Free, “Y”-Pattern, Class 125, bronze.
   3. Swing Check Valves, NPS 2 ½ and larger: Type II, Class 125, ductile iron.
   4. Spring-Loaded Check Valves, NPS 2 and Smaller: Class 125, Bronze, stainless steel spring.
   5. Gate Valves, NPS 3 in. and smaller: Lead-Free, Bronze, non-rising stem, Lead-Free, Class 125. NPS 4 in. and larger; Ductile iron body, Lead-Free, epoxy coated, flanged ends.

D. Recycled Water Piping: Valves shall be the same as for domestic water piping except as follows:
   1. Recycled Water Control Valves: Lever handle valves equipped with a locking feature and painted purple to match the Mylar wrapping tape. Lead-free is not required.

3.03 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

2. Lift Check Valves: With stem upright and plumb.

3.04 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.05 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 0523

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Hangers and supports for plumbing piping and equipment consists of furnishing transportation, labor, materials and equipment to furnish and install the following:
   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.

1.02 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. Related Sections include the following:
   1. Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 22 Section "Noise, Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 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."

1.04 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 for piping and equipment and obtain approval from authorities having jurisdiction.

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.
   4. Pipe positioning systems.

B. Welding certificates.

1.06 QUALITY ASSURANCE

A. Welding: Welding shall be performed only by qualified welders, and shall comply with ASME Boiler Construction Code, ANSI Code and State of California requirements.

B. Codes and Standards:
   1. All governing codes, ordinances and agencies, in accordance with the provisions of Division 1 of these specifications.

PART 2 PRODUCTS

2.01 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.

2.02 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. Anvil International.

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.

2.03 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.

2.04 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. Unistrut Corp.; Tyco International, Ltd.
   3. Anvil International.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.05 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield for 2 ½ in. and larger insulated piping.

B. Manufacturers:
   1. ERICO/Michigan Hanger Co.
   2. Pipe Shields, Inc.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

A. Concrete Inserts: Threaded-steel stud with fastener plate, for use in hardened Portland cement concrete used with structural metal decking. Pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers:

a. Tolco, Inc.
b. Mason Industries.

B. Mechanical-Expansion Anchors: Insert-wedge-type 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.
1. Manufacturers:
a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Hilti, Inc.
c. ITW Ramset/Red Head.
d. Powers Fasteners.

2.07 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. 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.

2.08 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.

2.09 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.

PART 3 EXECUTION

3.01 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. 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 30.
2. 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.

3. 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.
4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
5. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
6. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
7. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
8. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
9. 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.
10. 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.
11. 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.
12. 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.
13. 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.
14. 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.
15. 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.
16. 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.

F. 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.

G. 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. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
10. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
11. 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.
12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

H. 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.

I. 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.

J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

M. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.02 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. 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.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
   3. Install appropriate inserts before concrete placement on structural metal decking.

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.
   2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Section "Roof Accessories" for curbs.

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 "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. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. 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.

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.
      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 B31.9 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: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
      f. Pipes NPS 8 and Larger: Include wood inserts.
      g. Insert Material: Length at least as long as protective shield.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 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.

3.04 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.

3.05 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.

3.06 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 09

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 0529

SECTION 22 0548.13

VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.01 COMPONENTS

A. Vibration Isolators:

1. Elastomeric Isolation Pads: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area. Material to be oil and water resistant with elastomeric properties.
   a. Surface Pattern: Waffle pattern.
   b. Infused nonwoven cotton or synthetic fibers.
   c. Load-bearing metal plates adhered to pads.
2. Double-Deflection, Elastomeric Isolation Mounts: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
3. Restrained Elastomeric Isolation Mounts: All-directional isolator with seismic restraints; molded, oil-resistant elastomeric material with cast-ductile-iron or welded-steel housing.
4. Open-Spring Isolators: Freestanding, laterally stable.
5. Housed-Spring Isolators: Freestanding, laterally stable, open-spring isolators in two-part telescoping housing.
6. Restrained-Spring Isolators: Freestanding, laterally stable, open-spring isolators with vertical-limit stop restraint.
7. Housed-Restrained-Spring Isolators: Freestanding, steel, open-spring isolators with vertical-limit stop restraint in two-part telescoping housing.
8. Pipe-Riser Resilient Support: All-directional, acoustical pipe anchor.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring Hangers: Combination coil-spring and elastomeric-insert hangers with spring and insert in compression and with vertical-limit stop.
12. Conform to all aspects of the acoustical report for all piping and equipment vibration and noise control.

END OF SECTION 22 0548.13

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Identification for plumbing piping and equipment consists of furnishing transportation, labor, materials, and equipment to furnish and install the following:
   1. Pipe labels.
   2. Valve tags.

1.02 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. COMMON WORK RESULTS FOR PLUMBING - Section 220500

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.04 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 locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.05 QUALITY ASSURANCE

A. Codes and Standards:
   1. All governing codes, ordinances and agencies, in accordance with the provisions of Division 1 of these specifications.

PART 2 PRODUCTS

2.01 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/4 inches high for pipe sizes 2-1/2 to 6 inches, 3/4 inch high for pipe sizes 1-1/2 to 2 inches and 1/2 high for pipe sizes 1/2 to 1-1/4 inches.
   3. Color Field Length: At least 12 inches for pipe sizes 2-1/2 to 6 inches and 8 inches for pipe sizes 1/2 to 2 inches.
   4. Non-potable water systems shall have the words “CAUTION: NON-POTABLE WATER, DO NOT DRINK” in upper case lettering.

2.02 VALVE TAGS

A. Valve Tags: Provide a valve tag consisting of a 2 in. dia., 20 ga. brass disk for each valve with 1/2 in. letters identifying service designation. Fasten tags in place with continuous chain around valve stem.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed 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. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:
   1. Domestic Water Piping:
      a. Background Color: Green.
      b. Letter Color: White.
   2. Industrial Cold Water Piping:
      a. Background Color: Yellow
      b. Letter Color: Black
   3. Sanitary Waste and Storm Drainage Piping:
      a. Background Color: Green.
      b. Letter Color: White.

3.03 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units.

END OF SECTION 22 0553

SECTION 22 0719

PLUMBING PIPING INSULATION

1.01 QUALITY ASSURANCE

A. Surface-Burning Characteristics: Flame-spread index of 25, and smoke-developed index of 50 for insulation installed indoors; according to ASTM E 84.

B. Mockup of each type of pipe insulation and finish.

1.02 FIELD QUALITY CONTROL

A. Field Inspections: By Contractor-engaged agency.

1.03 PIPING INSULATION SCHEDULE, GENERAL

A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Below-grade piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

1.04 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water: mineral-fiber, preformed pipe insulation, Type I. Contractor shall install on all existing domestic hot water piping outside of the core restroom as part of this work.

B. Storm water and Overflow: mineral-fiber, preformed pipe insulation, Type I. Contractor shall install on all existing storm and overflow piping outside of the core restroom as part of this work.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities

END OF SECTION 22 0719

SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Domestic water piping consists of furnishing transportation, labor, materials, and equipment to furnish and install domestic water piping inside the building to 5 feet outside the building.

1.02 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 1, apply to this Section.

B. Common Work Results for Plumbing - Section 220500

C. Plumbing Specialties - Section 221119

1.03 REFERENCES

A. American Society of Mechanical Engineers (ASME)

1.04 SUBMITTALS

A. Product Data: For pipe, tube, fittings, couplings and sterilization report.

1.05 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.

C. Codes and Standards:
   1. All governing codes, ordinances and agencies, in accordance with the provisions of Division 1 of these specifications

D. Comply with the California Department of Health Services and City of San Jose requirements.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Materials when not otherwise definitely specified shall conform to the applicable standards.

2.02 DOMESTIC HOT AND COLD WATER PIPE AND FITTINGS

A. Above ground: ASTM B 88, ANSI B16.22, Type L, hard drawn copper tube and wrought copper fittings with soldered joints.

B. Below ground: ASTM B88, ANSI B16.22, Type K hard drawn copper tube and wrought copper fittings with soldered joints.

2.03 MATERIALS FOR JOINTS, FITTINGS AND VALVES

A. Solder and Flux:
   1. Equivalent to Harris “Bridget” lead-free solder alloy, ASTM B813 liquid and paste flux. 95-5 solders are not approved. Below ground piping shall have brazed joints with silver solder.

2.04 VALVES

A. Bronze general-duty valves are specified in General-Duty Valves Section.

B. Balancing and drain valves are specified in Plumbing Specialties Section.

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Earthwork and Trenching and Backfilling Sections.

3.02 PIPE AND FITTING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on above ground piping, unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on above ground copper tubing 1 ½-in. and larger.

D. Water-Service Piping on Service Side of Water Meter: Refer to Water Distribution Section.

E. Under-Building-Slab, (allowed only at areas as indicated on Drawings), Domestic Water, NPS 1 and Smaller: Hard copper tube, Type K. Trap primer lines, Hard copper tubing, Type L.

3.03 Valve APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements shall apply:
   1. Shutoff Duty: Use bronze ball for piping NPS 2 and smaller.
   2. Drain Duty: Hose-end drain valves.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

3.04 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Common Work Results for Plumbing Section.

B. Install under-building-slab copper tubing in conformance with CDA's Copper Tube Handbook.

C. Install HDPE or sheet metal 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 Common Work Results for Plumbing Section.

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Common Work Results for Plumbing Section.

E. Install shutoff valve, inside the building at domestic water service entrance.

F. Install domestic water piping level without pitch.

G. Wrap underground copper pipe with a minimum of 8 mils of dielectric (nonconductive), continuous “holiday” free (no “open” joints or seams; no holes or tears) polyethylene sleeve. All seams and other openings must be sealed with polyethylene tape. Do not tape wrap buried copper piping. Backfill copper piping with clean sand a minimum of 4 inches all around pipe and fittings.

3.05 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Common Work Results for Plumbing Section.

B. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B828 procedure, unless otherwise indicated.

C. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

D. Brazed Joints: Construct joints accoring to AWS “Brazing Handbook” Pipe and Tube chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

3.06 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint Devices: Noise, Vibration and Seismic Controls of Plumbing Piping and Equipment Section.

B. Pipe Hanger and Support Devices are specified in Hangers and Supports for Plumbing Piping and Equipment Section. Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 1, adjustable steel clevis hangers.

C. Install supports in conformance with Hangers and Supports for Plumbing Piping and Equipment Section.

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 a minimum of 3/8 inch.

F. Install hangers for copper tubing in compliance with the CPC.

G. Install supports for vertical copper tubing in compliance with the CPC.

3.07 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 water-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 indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Plumbing Fixtures Section.
   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 3 and larger.

3.08 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      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 final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in piping. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   3. Leave domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. 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.
   5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

C. Both domestic water systems shall undergo a complete thorough cross-connection test witnessed by the Health Department prior to being placed into service.

3.09 ADJUSTING

A. Perform the following adjustments 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. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
      a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
      b. Adjust calibrated balancing valves to flows indicated.
   5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
   6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
   8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:
   1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 22 1116

SECTION 22 1119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Vacuum breakers.
   2. Backflow preventers.
   3. Water pressure-reducing valves.
   4. Balancing valves.
   5. Temperature-actuated, water mixing valves.
   6. Strainers.
   7. Hose bibbs.
   8. Wall hydrants.
   9. Drain valves.
   10. Water-hammer arresters.
   11. Trap-seal primer valves.

B. Related Requirements:
   1. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
   2. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

B. Comply with NSF 372 for low lead.

2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 (860) psig (kPa) unless otherwise indicated.

2.03 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers :
   1. Standard: ASSE 1012.
   2. Operation: Continuous-pressure applications.
   3. Size: NPS 1/2 (DN 15) NPS 3/4 (DN 20).
   4. Body: Bronze.
   5. End Connections: Union joint.

6. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:
   1. Standard: ASSE 1013.
   2. Operation: Continuous-pressure applications.
   3. End Connections: Threaded for NPS 2 (DN 50) and smaller

C. Double-Check, Backflow-Prevention Assemblies <**Insert drawing designation if any**>:
   1. Standard: ASSE 1015.
   2. Operation: Continuous-pressure applications unless otherwise indicated.

2.04 WATER PRESSURE-REDUCING VALVES

A. Water Regulators
   1. Standard: ASSE 1003.
   2. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
   3. Size: See Drawing
   4. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller.
   5. End Connections: Threaded for NPS 2 (DN 50) and smaller.

2.05 BALANCING VALVES

A. Memory-Stop Balancing Valves: See Drawings
   1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
   2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
   3. Size: NPS 2 (DN 50) or smaller.
   4. Body: Copper alloy.
   5. Port: Standard or full port.
   6. Ball: Chrome-plated brass.
   7. Seats and Seals: Replaceable.
   8. End Connections: Solder joint or threaded.
   9. Handle: Vinyl-covered steel with memory-setting device.

2.06 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
   1. Standard: ASSE 1017.
   2. Pressure Rating: 125 psig (860 kPa).
   3. Type: Thermostatically controlled, water mixing valve.
   4. Material: Bronze body with corrosion-resistant interior components.
   5. Connections: Threaded inlets and outlet.
   6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
   7. Tempered-Water Setting: See Drawing
   8. Tempered-Water Design Flow Rate: See Drawing

2.07 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers
   1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
   2. Body: Bronze for NPS 2 (DN 50) and smaller.
   3. End Connections: Threaded for NPS 2 (DN 50) and smaller.
   4. Screen: Stainless steel with round perforations unless otherwise indicated.
   5. Drain: Factory-installed, hose-end drain valve.

2.08 HOSE BIBBS

A. Hose Bibbs: Hose bibbs shall be installed in all restrooms
   1. Standard: ASME A112.18.1 for sediment faucets.
   2. Body Material: Bronze.
   3. Seat: Bronze, replaceable.

4. Supply Connections: NPS 3/4 DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral, nonremovable complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include two operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

B. Moderate-Climate Wall Hydrants : At all outdoor patios
1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig (860 kPa).
3. Operation: Loose key.
4. Inlet: NPS 3/4 (DN 25).
5. Outlet:
   a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
   b. Garden-hose thread complying with ASME B1.20.7.
6. Box: Deep, flush mounted with cover.
7. Box and Cover Finish: Polished nickel bronze.
8. Outlet:
   a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
   b. Garden-hose thread complying with ASME B1.20.7.
9. Nozzle and Wall-Plate Finish: Polished nickel bronze.
10. Operating Key(s): Two with each wall hydrant.

2.09 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device: See Drawing
1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig (860 kPa) minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device: See Drawing

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
2. Size: NPS 1-1/4 (DN 32) minimum.
3. Material: Chrome-plated, cast brass.

PART 3 EXECUTION

3.01 INSTALLATION

A. Backflow Preventers: 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 authorities having jurisdiction.
   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 unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.

C. Balancing Valves: Install in locations where they can easily be adjusted.

D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Supply-Type, Trap-Seal Primer Device: Install 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.

F. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.02 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

C. Comply with requirements for grounding equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.03 IDENTIFICATION

A. Plastic Labels for Equipment: 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. Automatic water shutoff valves.
   11. Calibrated balancing valves.
   12. Primary, thermostatic, water mixing valves.
   13. Manifold, thermostatic, water mixing-valve assemblies.
   14. Photographic-process, thermostatic, water mixing-valve assemblies.
   15. Primary water tempering valves.

16. Outlet boxes.
17. Hose stations.
18. Supply-type, trap-seal primer valves.
19. Trap-seal primer systems.

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 Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.05 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 1123.21

INLINE, DOMESTIC-WATER PUMPS

1.01 PRODUCTS

A. In-Line, domestic hot water circulating pump:
   1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type.
   2. Casing: Bronze.
   3. Impeller: Stainless steel.
   4. Motor: Ultra low noise.
   5. Smart controls.

B. Controls:
   1. Smart controller
      a. Pressure and flow sensor.
      b. Operation of Pump: On or off.
      c. Programmable timer.
      d. Flow control of hot-water circulation
      e. Building management compatible.

END OF SECTION 1123.21

SECTION 22 1316

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. SANITARY WASTE AND VENT PIPING consists of furnishing transportation, labor, materials, and equipment to furnish and install the following for soil, waste, and vent piping inside the building:
   1. Pipe and fittings.
   2. Special pipe fittings.
   3. Encasement for underground metal piping.

B. The contractor shall perform a condition assessment of all underground sanitary and storm piping by means of video inspection. The contractor shall submit an assessment report to the architect of record. Any breaks, clogs or deterioration of pipe shall be reported to the architect and engineer within two (2) days of discovery.

1.02 RELATED WORK

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.

B. COMMON WORK RESULTS FOR PLUMBING - Section 220500

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM International)

B. American Water Works Association (AWWA)

C. Cast Iron Soil Pipe Institute (CISPI)

D. Sheet Metal and Air Condition Contractor's National Association (SMACNA)

1.04 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.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be in conformance with the SMACNA Guidelines.

1.05 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.06 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Codes and Standards:
   1. All governing Codes, Ordinances and Agencies in accordance with the provisions of Division 1 of these specifications.

PART 2 PRODUCTS

2.01 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:
   1. Soil, waste, vent and storm drain piping to 5 feet outside building: Cast-iron soil pipe and fittings conforming to the requirements of CISPI Standard 301, ASTM A888 or ASTM A74 for all pipe and fittings. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the Engineer. Wrap all underground piping per paragraph 3.3 G, 1 herein.
      a. Manufacturers:

1) Tyler Pipe
2) A.B. & I
3) Charlotte Pipe and Foundry

B. Shielded Couplings: ASTM C1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
1. Above Ground: Type 300 Series stainless steel, "No-Hub" standard duty, shielded couplings as approved by the Cast Iron Soil Pipe Institute, CISPI-310-85 with stainless steel corrugated shield, stainless steel bands and tightening devices and ASTM C564 rubber sleeve. Equivalent to Tyler.
2. Below Ground: Type 304 stainless steel, "No-Hub" by the Cast Iron Soil Pipe Institute, CISPI-310-85 with stainless steel shield, stainless steel band and tightening devices and ASTM C564 rubber sleeve. Equivalent to Husky HD-2000.
a. Manufacturers:
1) Clamp-All Corporation
2) Husky Technologies.
3) Tyler Pipe; Soil Pipe Division

PART 3 EXECUTION

3.01 EXCAVATION

A. Refer to EARTHWORK and TRENCHING AND BACKFILLING Sections for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

A. Above Ground Soil, Waste and Vent Piping: No-Hub cast-iron soil pipe and fittings; standard-duty shielded, stainless-steel couplings. Copper DWV pipe and fittings may be used where applicable.

B. Below Ground Soil, Waste and Vent Piping: No-Hub cast-iron soil pipe and fittings; heavy duty shielded, stainless-steel couplings, or ASTM D1784/1785/2665 Solid wall, PE, 1.5 in. – 12 in., schedule 40 PVC Pipe with schedule 40 PVC fittings. Copper DWV pipe and fittings may be used where applicable. Wrap below ground cast iron piping per section 3.3. G-1.

3.03 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in civil drawings.

B. Basic piping installation requirements are specified in common work results for plumbing section 220500.

C. Install seismic restraints on piping. Seismic-restraint devices shall be installed as required by state and local code. Noise controls of plumbing piping is extremely significant and must be part of the project scope.

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install HDPE or sheet metal 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 PLUMBING SPECIALTIES Section 221119.

F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

G. Install cast-iron soil piping in conformance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. All in ground piping install 8 mil. Polyethylene encasement on underground piping in conformance with ASTM A674 or AWWA C105/ANSI AZ1.5. Backfill with clean sand a minimum of 4 inches all around pipe and fittings.

H. 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.

I. Install soil and waste drainage piping at 2 percent minimum slope, unless otherwise indicated on Drawings:

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in COMMON WORK RESULTS FOR PLUMBING Section 220500.

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.

3.05 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices as specified per code.

B. Install supports according to Hangers and Supports Section.

C. Support vertical piping and tubing at base and at each floor.

D. Horizontal cast-iron no-hub piping: Provide hangers or supports as required per the California Plumbing Code Table 313.1.

E. Install hangers for cast-iron soil piping with maximum horizontal spacing and minimum rod diameters in accordance with the requirements of the California Plumbing Code.

3.06 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 the CPC.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by the CPC.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by the CPC.

3.07 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   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 authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of the authorities having jurisdiction or, in absence of published procedures, in accordance with the requirements of the California Plumbing Code.

3.08 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 1319.13
SANITARY DRAINS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Floor drains.
   2. Floor sinks.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains. See drawings for more information.
   1. Standard: ASME A112.6.3.
   2. Pattern: Floor drain.
   3. Body Material: Gray iron.
   4. Anchor Flange: Required.
   5. Clamping Device: Required.
   6. Outlet: Bottom.
   7. Sediment Bucket: Not required.
   8. Top or Strainer Material: See drawing.
   9. Top of Body and Strainer Finish: See drawing.
   10. Top Shape: See drawing.

2.03 FLOOR SINKS

A. Cast-Iron Floor Sinks See drawings for more information.
   1. Standard: ASME A112.6.7.
   2. Pattern: Floor drain.
   3. Body Material: Cast iron.
   4. Anchor Flange: Required
   5. Clamping Device: Required.
   6. Outlet: Bottom connection.
   7. Coating on Interior Surfaces: Acid-resistant enamel.
   8. Internal Strainer: Dome.
   9. Internal Strainer Material: Aluminum.
   10. Top Grate Material: See drawing.
   11. Top Shape: See drawing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
      b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
      c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
   4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
      a. Maintain integrity of waterproof membranes where penetrated.
   5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.02 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

D. Install piping adjacent to equipment to allow service and maintenance.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.03 LABELING AND IDENTIFYING

A. 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 Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 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 1319.13

SECTION 22 1413

FACILITY STORM DRAINAGE PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Hubless, cast-iron soil pipe and fittings.
   2. Specialty pipe and fittings.

B. Related Requirements:
   1. Section 334400 "Stormwater Utility Equipment" for storm drainage piping outside the building.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roof drainage system. Include calculations, plans, and details.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 PRODUCTS

2.01 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 (30 kPa).

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:
   1. Marked with CISPI collective trademark and NSF certification mark.
   2. Standard: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:
   1. Couplings shall bear CISPI collective trademark and NSF certification mark.
   2. Standards: ASTM C 1277 and CISPI 310.
   3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:
   1. Required to be installed at all sensitive areas within the building and over any sound rooms.
   2. Standard: ASTM C 1540.
   3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C 1173.
   b. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   c. 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.

PART 3 EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   2. Install piping as indicated unless deviations from 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 at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
   1. Do not change direction of flow more than 90 degrees.
   2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

M. Install piping at the following minimum slopes unless otherwise indicated:
   1. Revise "Building Storm Drain" and "Horizontal Storm Drainage Piping" subparagraphs below as required by authorities having jurisdiction.
   2. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
   3. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

N. 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."

O. Plumbing Specialties:
   1. Install backwater valves in storm drainage gravity-flow piping.
      a. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
   2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
      a. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
   3. Install drains in storm drainage gravity-flow piping.
      a. Comply with requirements for drains specified in all sections.

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints:
   1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Joint Restraints and Sway Bracing:
   1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
      a. Provide axial restraint for pipe and fittings 5 inches (125 mm) and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
      b. Provide rigid sway bracing for pipe and fittings 4 inches (100 mm) and larger, upstream and downstream of all changes in direction 45 degrees and greater.
      c. Provide rigid sway bracing for pipe and fittings 5 inches (125 mm) and larger, upstream and downstream of all changes in direction and branch openings.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Drainage Piping: Shielded, nonpressure transition couplings.

B. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
   2. Install backwater valves in accessible locations.
   3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.05 HANGER AND SUPPORT INSTALLATION

A. Retain first paragraph below if Project is in seismic area. Retain second paragraph if Project is not in seismic area.

B. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   4. Vertical Piping: MSS Type 8 or Type 42, clamps.
   5. Install individual, straight, horizontal piping runs:
      a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
   6. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   7. Base of Vertical Piping: MSS Type 52, spring hangers.

D. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting and coupling.

E. Support vertical piping and tubing at base and at each floor.

F. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

G. Maximum spans in remaining paragraphs were taken from MSS SP-58 for water service and from model plumbing codes. The most restrictive piping and spacing dimensions allowed are indicated. For large piping, maximum spans indicated may result in excessive point loads. Coordinate with Project structural engineer.

H. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
   4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
   5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
   6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

I. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

J. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.06 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.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
   2. Where installing piping adjacent to equipment, allow space for service and maintenance.
   3. Larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.07 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   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 authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction 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.
      a. 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.
      a. Expose work that was covered or concealed before it was tested.
   3. Test Procedure:
      a. Test storm drainage piping on completion of roughing-in.
      b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until 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.

C. Piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.09 CLEANING AND PROTECTION

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.

3.10 PIPING SCHEDULE

A. Retain and revise applicable piping applications in this article. Coordinate with materials specified.

B. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

C. Retain “any of" option in first paragraph below to allow Contractor to select piping materials from those retained.

D. Aboveground storm drainage piping NPS 6 (DN 150) and smaller shall be the following:

1. Retain one or more of first four subparagraphs below. If using more than one type of material and joining method, identify various materials on Drawings and show points of transition from one material to another.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Retain “any of" option in first paragraph below to allow Contractor to select piping materials from those retained.

F. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be the following:
1. Retain one or more of first three subparagraphs below. If using more than one type of material and joining method, identify various materials on Drawings and show points of transition from one material to another.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

G. Retain “any of" option in first paragraph below to allow Contractor to select piping materials from those retained.

H. Underground storm drainage piping NPS 6 (DN 150) and smaller shall be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

I. Retain “any of" option in paragraph below to allow Contractor to select piping materials from those retained.

J. Underground, storm drainage piping NPS 8 (DN 200) and larger shall be the following:
1. Retain one or more of first four subparagraphs below. If using more than one type of material and joining method, identify various materials on Drawings and show points of transition from one material to another.
2. PVC piping in first subparagraph below is limited in size to NPS 12 (DN 300).
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 1413

SECTION 22 3400

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Gas-fired, tankless, domestic-water heaters.
   2. Domestic-water heater accessories.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces.

1.04 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   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.

B. Product Certificates: For each type of gas-fired, tankless, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

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.

B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:
   1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.08 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Periods: From date of Substantial Completion.
      a. Gas-Fired, Tankless, Domestic-Water Heaters:
         1) Heat Exchanger: Five years.
         2) Controls and Other Components: Three years.
      b. Compression Tanks: Five years.

PART 2 PRODUCTS

2.01 GAS-FIRED, TANKLESS, DOMESTIC-WATER HEATERS

A. See drawing schedule for more information.

B. Standard: ANSI Z21.10.3/CSA 4.3 for gas-fired, instantaneous, domestic-water heaters for indoor application.

C. Construction: Copper piping or tubing complying with NSF 61 Annex G barrier materials for potable water, without storage capacity.
   1. Tappings: ASME B1.20.1 pipe thread.
   2. Pressure Rating: 150 psig (1035 kPa).
   3. Heat Exchanger: Copper tubing.
   4. Insulation: Comply with ASHRAE/IESNA 90.1
   5. Jacket: Metal, with enameled finish, or plastic.
   6. Burner: For use with tankless, domestic-water heaters and natural-gas fuel.
   7. Automatic Ignition: Manufacturer's proprietary system for automatic, gas ignition.
   8. Temperature Control: Adjustable thermostat.

D. Support: Bracket for wall mounting.

2.02 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:
   1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
   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 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

c. Air-Charging Valve: Factory installed.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Comply with requirements for ball- shutoff valves.
   1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

E. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

F. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating as required to match gas supply.

G. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

H. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.
   1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

J. Domestic-Water Heater Stands: Heater is wall mounted.

K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply.

D. Prepare test and inspection reports.

PART 3 EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Tankless, Domestic-Water Heater Mounting: Install tankless, domestic-water heaters at least 36” inches (457 mm) above floor on wall bracket.
   1. Maintain manufacturer's recommended clearances.
   2. Arrange units so controls and devices that require servicing are accessible.
   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. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters 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.
   1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified.

C. Install gas-fired, domestic-water heaters according to NFPA 54.
   1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.

2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified.

D. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified.

E. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater 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 domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in schedule.

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 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.
2. Leak Test: After installation, charge system 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 operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired, tankless domestic-water heaters.

END OF SECTION 22 3400

SECTION 22 4000

PLUMBING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes plumbing fixtures and related components.

B. Related Sections include the following:

1. Division 22 Section "Plumbing Specialties" for backflow preventers and specialty fixtures not in this Section.

1.03 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.

1.04 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. Maintenance Data: Maintenance recommendations for plumbing fixtures are to be included in maintenance manuals specified in Division 1.

1.05 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 NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. 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"; about plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.

E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow 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.

1. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Stainless Steel Fixtures other than Service Sinks: ASME A112.19.3M.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
   2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
   3. Faucets: ASME A112.18.1M.
   4. NSF Materials: NSF 61.
   5. Pipe Threads: ASME B1.20.1.
   6. Supply and Drain Fittings: ASME A112.18.1M.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   1. Brass and Copper Supplies: ASME A112.18.1M.
   2. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Pipe Threads: ASME B1.20.1.
   2. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 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

2.01 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.

2.02 FIXTURES

A. Refer to drawings for specifications.

PART 3 EXECUTION

3.01 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.

3.02 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install counter-mounting fixtures in and attached to casework.

C. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

D. 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.

E. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

F. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

G. 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.

H. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

I. 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.

J. Install traps on fixture outlets.

K. 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 23 Section "Basic Mechanical Materials and Methods" for escutcheons.

L. Seal joints between fixtures, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.03 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.

3.04 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.

3.05 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets, and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.06 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.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

END OF SECTION 22 4000

SECTION 22 4716
PRESSURE WATER COOLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes pressure water coolers and related components.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of pressure water cooler.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.04 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. Filter Cartridges: Equal to one percent of quantity installed for each type and size indicated, but no fewer than one of each.

PART 2 PRODUCTS

2.01 PRESSURE WATER COOLERS AND HYDRATION STATIONS

A. Pressure Water Coolers See drawings for more information.
   1. Standards:
      a. Comply with NSF 61 Annex G.
      b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
   2. Bubbler: One, with adjustable stream regulator, located on deck.
   3. Control: Push button
   4. Drain: Grid with NPS 1-1/4 (DN 32) tailpiece.
   5. Supply: NPS 3/8 (DN 10) with shutoff valve.
   6. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.
   7. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
   8. Cooling System: Electric, with precooler hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
      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.
   9. Capacities and Characteristics:
      a. See drawing schedule for more information.

2.02 SUPPORTS

A. Type I Water Cooler Carrier:
   1. Standard: ASME A112.6.1M.

B. Type II Water Cooler Carrier:
   1. Standard: ASME A112.6.1M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set freestanding pressure water coolers on floor.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation.

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.03 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.05 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4716

SECTION 23 0513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. 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.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. 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.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed 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. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. 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.

PART 3 EXECUTION – NOT USED

END OF SECTION 23 0513

SECTION 23 0518
ESCUTCHEONS FOR HVAC PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Escutcheons.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.01 ESCUTCHEONS

A. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Insulated Piping: split-plate, stamped-steel type with concealed hinge.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: or split-plate, stamped-steel type with concealed hinge. Retain one of first two subparagraphs below.
      c. Bare Piping at Ceiling Penetrations in Finished Spaces: or split-plate, stamped-steel type with concealed hinge. Retain one of first two subparagraphs below.
      d. Bare Piping in Unfinished Service Spaces: or split-plate, stamped-steel type with concealed hinge.
      e. Bare Piping in Equipment Rooms: or split-plate, stamped-steel type with concealed hinge.

3.02 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 23 0518

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Equipment supports.

B. Related Requirements:
   1. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
   2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For trapeze hangers 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 trapeze hangers.
   2. Include design calculations for designing trapeze hangers.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment.

2.02 METAL PIPE HANGERS AND SUPPORTS

A. Copper Pipe and Tube Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

2.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Channels: Continuous slotted carbon-steel channel with inturned lips.
   4. Channel Width: Selected for applicable load criteria.
   5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
   7. Metallic Coating: Pregalvanized G90 (Z275).

2.05 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psi or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psi or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Indoor Applications: Zinc-coated steel.
   2. Outdoor Applications: Stainless steel.

2.07 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Bridge channel supports – DURA-BLOK™ DB10 Series; Dimensions 6-inch wide by 5 5⁄8-inch tall, length as required. Standard strut accessories can be used for attachment.

2.08 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.09 MATERIALS

A. Carbon Steel: ASTM A 1011/A 1011M.

B. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; galvanized.

C. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

D. Grout: ASTM C 1107/C 1107M, 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

3.01 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

3.02 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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 for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
   1. Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:
   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 allowed by ASME B31.9 for building services piping.

2. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
3. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.05 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.

3.06 PAINTING

A. Touchup: 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 a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.07 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 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 copper-plated pipe hangers and copper attachments for copper piping and tubing.

F. Use thermal-hanger shield inserts for insulated piping and tubing.

G. 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 30 (DN 15 to DN 750).
   2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
   3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
   4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
   5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
   6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
   10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
   11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
   12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   13. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
   14. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
   15. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
   16. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
   17. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

H. 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 24 (DN 24 to DN 600).
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

J. 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. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
3. 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 (340 kg).
   b. Medium (MSS Type 32): 1500 lb (680 kg).
   c. Heavy (MSS Type 33): 3000 lb (1360 kg).
4. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
5. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
6. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

K. 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.

L. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 0529

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Restrained-spring isolators.
   2. Restraint cables.
   3. Seismic-restraint accessories.
   4. Mechanical anchor bolts.
   5. Vibration isolation equipment bases.
   6. Spring hangers.

B. Related Requirements:
   1. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.03 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
      b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Welding certificates.

C. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, 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 professional engineer.

PART 2 PRODUCTS

2.01 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
   1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
      a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
      b. Top plate with threaded mounting holes.
      c. Internal leveling bolt that acts as blocking during installation.
   2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
   3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.02 RESTRAINT CABLES

A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.03 SEISMIC-RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

B. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

C. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.04 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.05 CRAC UNIT ISOLATION

A. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    a. 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 brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Concrete Inertia Base: Inertia bases shall be of welded steel construction with concrete in-fill supplied by the installing contractor on site and shall incorporate reinforcing bars, spaced 300 mm (12”) maximum on centers each way.
1. Inertia bases for pumps shall be of sufficient size to accommodate supports for pipe elbows at pump suction and discharge connections (if this information has been provided for configuration).
2. Inertia bases for fans shall include motor slide rails as indicated on their Schedule.
3. The weight of each inertia base shall be sufficient to lower the center of gravity to or below the isolator support plane.
4. Inertia bases shall be a minimum of 150 mm (6”) thick. (See ASHRAE Sandards).

C. Isolators:
1. Free Spring Floor Mounted Isolators: Type FDS – Vibration isolators shall be free standing, unhoused, laterally stable springs wound from high strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be supported either with a neoprene cup or a metal base plate complete with a ribbed neoprene pad, minimum 6 mm (0.25”) thick, bonded to the base plate. Springs shall be selected to provide operating static deflections as required. Springs shall be color coded or otherwise identified to indicate load capacity. In capacities up to 5,000 lbs., spring shall be replaceable. In Capacities over 5,000 lbs., springs shall be welded to the top and bottom load plate assemblies. Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with a steel leveling bolt lock nut and washer for attachment to the supported equipment. The lower load plate shall have a non-skid noise isolation pad bonded to the bottom and have provisions for bolting the isolator to the supporting structure. Spring isolation mounts for floor-mounted equipment shall be Model FDS, as manufactured by Kinetics Noise Control, Inc.
    a. Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have kx/ky ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.

D. Provide HS-502 snubber per Kinetics Noise Control installed per manufacturer.

E. Provide KCCA B – 38 – 375 Cracked Concrete Anchors per Kinetic Noise Control installed per manufacturer.

F. 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.

2.06 SPRING HANGERS

A. Spring Hangers: Vibration isolator hanger supports with steel springs and welded steel housings. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit. Hangers serving lightweight loads 0.90 kN (200 lbs) and less may be exempt from this requirement.

1. Vibration isolators for suspended equipment with minimum static deflection requirement exceeding .4", and where both high and low frequency vibrations are to be isolated, shall be hangers consisting of a laterally stable steel spring in series with a molded oil-resistant neoprene insert, complete with load transfer plates and assembled in stamped or welded steel bracket. The combination isolation hanger assembly with neoprene inserts shall be Model SRH, as manufactured by Kinetics Noise Control, Inc or Mason Industries 30N.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:
   1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Test and adjust restrained-air-spring isolator controls and safeties.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust isolators after piping system 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.

3.07 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete." Section 033053, "Miscellaneous Cast-in-Place Concrete."

END OF SECTION 23 0548

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Equipment labels.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Letter Color: Black.
   3. Background Color: White.
   4. Minimum Label Size: Length and width vary for required label content, but not less than 3 by 3/4 inch (64 by 19 mm).
   5. Minimum Letter Size: 2 inch
   6. Fasteners: Stainless-steel rivets or self-tapping screws.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black.
   3. Background Color: White.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
   6. Minimum Letter Size: 1 inch (13 mm) for viewing distances up to 72 inches (1830 mm).
   7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

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 locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.04 EQUIPMENT-TAG INSTALLATION

A. Use metal tags outdoors.

B. Use metal tags indoors.

END OF SECTION 23 0553

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
   2. Testing, Adjusting, and Balancing Equipment:
      a. Motors.
      b. Condensing units.
   3. Testing, adjusting, and balancing existing systems and equipment.
   4. Control system verification.

1.03 DEFINITIONS

A. Retain definition(s) remaining after this Section has been edited.

B. AABC: Associated Air Balance Council.

C. BAS: Building automation systems.

D. NEBB: National Environmental Balancing Bureau.

E. TAB: Testing, adjusting, and balancing.

F. TABB: Testing, Adjusting, and Balancing Bureau.

G. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

H. TDH: Total dynamic head.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

E. Certified TAB reports.

F. Sample report forms.

G. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.05 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB or TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan curves.
1. 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.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. 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.

3.02 PREPARATION

A. Prepare a TAB plan that includes the following:
1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
   1. Airside:
      a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
      b. Duct systems are complete with terminals installed.
      c. Volume, smoke, and fire dampers are open and functional.
      d. Clean filters are installed.
      e. Fans are operating, free of vibration, and rotating in correct direction.
      f. Variable-frequency controllers' startup is complete and safeties are verified.
      g. Automatic temperature-control systems are operational.
      h. Ceilings are installed.
      i. Windows and doors are installed.
      j. Suitable access to balancing devices and equipment is provided.
   2. Hydronics:
      a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
      b. Piping is complete with terminals installed.
      c. Water treatment is complete.
      d. Systems are flushed, filled, and air purged.
      e. Strainers are pulled and cleaned.
      f. Control valves are functioning per the sequence of operation.
      g. Shutoff and balance valves have been verified to be 100 percent open.
      h. Pumps are started and proper rotation is verified.
      i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
      j. Variable-frequency controllers' startup is complete and safeties are verified.
      k. Suitable access to balancing devices and equipment is provided.

3.03 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 Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
   2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
   3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check 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 outdoor-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. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.05 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 total airflow.
      a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
      b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   2. Measure fan static pressures as follows:
      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.
      c. Measure static pressure across each component that makes up the air-handling system.
      d. Report artificial loading of filters at the time static pressures are measured.
   3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments
   4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
   5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
   1. Measure airflow of submain and branch ducts.
   2. Adjust submain and branch duct volume dampers for specified airflow.
   3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
   1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   2. Measure inlets and outlets airflow.
   3. Adjust each inlet and outlet for specified airflow.
   4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.06 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer's name, model number, and serial number.
   2. Motor horsepower rating.
   3. Motor rpm.
   4. Phase and hertz.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter size and thermal-protection-element rating.
   8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.07 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.08 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
   1. Measure and record the operating speed, airflow, and static pressure of each fan.
   2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   3. Check the refrigerant charge.
   4. Check the condition of filters.
   5. Check the condition of coils.
   6. Check the operation of the drain pan and condensate-drain trap.
   7. Check bearings and other lubricated parts for proper lubrication.
   8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
   1. New filters are installed.
   2. Coils are clean and fins combed.
   3. Drain pans are clean.
   4. Fans are clean.
   5. Bearings and other parts are properly lubricated.
   6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
   1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
   2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.09 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.
   3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB specialist.
   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 supervisor 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's name, type, size, and fittings.
   14. Notes to explain why certain final data in the body of reports vary from indicated values.
   15. Test conditions for fans performance forms including the following:
      a. Settings for outdoor-, 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.

D. 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 outdoor, 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.

E. Fan Coil-Unit & Package Unit Test Reports: For units with coils, include the following:
   1. Unit Data:
      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 (mm), and bore.
      i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
      j. Number, make, and size of belts.
      k. Number, type, and size of filters.
   2. Motor Data:
      a. Motor 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 (mm), and bore.
      f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
   3. Test Data (Indicated and Actual Values):
      a. Total airflow rate in cfm (L/s).
      b. Total system static pressure in inches wg (Pa).
      c. Fan rpm.
      d. Discharge static pressure in inches wg (Pa).
      e. Filter static-pressure differential in inches wg (Pa).
      f. Coils static-pressure differential in inches wg (Pa).
      g. Outdoor airflow in cfm (L/s).
      h. Return airflow in cfm (L/s).
      i. Outdoor-air damper position.
      j. Return-air damper position.

F. 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 (mm) o.c.
      f. Make and model number.
      g. Face area in sq. ft. (sq. m).
      h. Tube size in NPS (DN).
      i. Tube and fin materials.
      j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
    a. Airflow rate in cfm (L/s).
    b. Average face velocity in fpm (m/s).
    c. Air pressure drop in inches wg (Pa).
    d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
    e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
    f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
    g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
    h. Refrigerant expansion valve and refrigerant types.
    i. Refrigerant suction pressure in psig (kPa).
    j. Refrigerant suction temperature in deg F (deg C).

G. 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 (mm), and bore.
    h. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
2. Motor Data:
    a. Motor 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 (mm), and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm (L/s).
    b. Total system static pressure in inches wg (Pa).
    c. Fan rpm.
    d. Discharge static pressure in inches wg (Pa).
    e. Suction static pressure in inches wg (Pa).

H. 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 (deg C).
    d. Duct static pressure in inches wg (Pa).
    e. Duct size in inches (mm).
    f. Duct area in sq. ft. (sq. m).
    g. Indicated airflow rate in cfm (L/s).
    h. Indicated velocity in fpm (m/s).
    i. Actual airflow rate in cfm (L/s).
    j. Actual average velocity in fpm (m/s).
    k. Barometric pressure in psig (Pa).

I. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

END OF SECTION 23 0593

SECTION 23 0713

DUCT INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply return and outdoor air.

B. Related Sections:
   1. Section 230719 "HVAC Piping Insulation."
   2. Section 233113 "Metal Ducts" for duct liners.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.05 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 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.

1.06 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.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. 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. Manufacturer’s
      a. Johns Manville
      b. Certain Teed
      c. Knauf

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   4. Color: White.

2.04 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.

2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.05 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.06 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches
   2. Thickness: 6.5 mils
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.07 SECUREMENTS

A. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   3. 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. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
   4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, galvanized steel].

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, 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.
   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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. 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. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. 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.

3.04 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: 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 Section 078413 "Penetration Firestopping."

3.05 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld 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, place 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 may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not over compress insulation during installation.
      e. Impale insulation over pins and attach speed washers.
      f. 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 one edge and one 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, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
      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 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped 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 two times the insulation thickness, but not less than 3 inches.
   5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
   6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
   7. 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.

3.06 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, supply, return and outdoor air.
   2. Ductwork located in exposed locations to be lined per section 233113 “Metal Ducts”.

B. Items Not Insulated:
   1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   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.

3.07 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed round and rectangular, supply outside, and return air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick with a minimum installed R-valve of 4.2.

B. Exposed round and rectangular, supply outside and return air duct insulation shall be lined per Section 233113 Metal Ducts.

END OF SECTION 23 0713

SECTION 23 0716
HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Surface-Burning Characteristics: Flame-spread index of 25, and smoke-developed index of 50 for insulation installed indoors; according to ASTM E 84.

B. Mockup of each type of equipment insulation and finish.

1.02 FIELD QUALITY CONTROL

A. Field Inspections: By Contractor-engaged agency.

1.03 EQUIPMENT INSULATION SCHEDULE

A. Fan-Coil Units: To be defined by acoustical engineer.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 23 0716

SECTION 23 0719

HVAC PIPING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Condensate drain piping, indoors and outdoors.
   2. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:
   1. Section 230713 "Duct Insulation."
   2. Section 230716 "HVAC Equipment Insulation."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   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.
   5. Detail application of field-applied jackets.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.05 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 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.

1.06 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.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   4. Color: White.

C. Vapor-Barrier Mastic: Suitable for indoor use on below-ambient services.

2.04 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

2. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
3. Color: White.

2.05 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.

2.06 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. 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. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

2.07 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

2.08 SECUREMENTS

A. Bands:
1. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems 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.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, 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.
   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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install 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 [2 inches (50 mm)] [4 inches (100 mm)] o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

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 (100 mm) 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.

3.04 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 (50 mm) below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   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. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   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. Fill joints, seams, and irregular surfaces with insulating cement.

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.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. 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.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. 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.

C. 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.

3.07 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's 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.

3.08 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified by architect.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.09 PIPING INSULATION SCHEDULE, GENERAL

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.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
   1. All Pipe Sizes: Insulation shall be[one of] the following:
      a. Flexible Elastomeric: 3/4 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:
   1. All Pipe Sizes: Insulation shall be[one of] the following:
      a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 2 inches thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. None.

D. Piping, Exposed:
   1. None.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. PVC: 30 mils thick.

END OF SECTION 23 0719

SECTION 23 0923.18

LEAK DETECTION INSTRUMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes the following types of leak-detection switches:
   1. Cable-type, leak-detection switches.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:
   1. Operating characteristics, electrical characteristics, and furnished accessories indicating control signal, default control signal with loss of power, and electrical power requirements.
   2. Product description with complete technical data and product specification sheets.
   3. Installation operation and maintenance instructions including factors affecting performance.

B. Shop Drawings:
   1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.
   3. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: To include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 LEAK-DETECTION SWITCHES

A. Cable-Type, Leak-Detection Switches:
   1. Control Module Features:
      a. Power and alarm LEDs.
      b. Alarm test switch.
      c. Continuous tape integrity self-check.
   2. Performance:
      a. Service: Water, or other conductive liquid.
      b. Switch Type: DPDT.
      c. Electric Connection: Screw terminals.
      d. Conduit Connection: 0.5 inch.
   3. Construction:
      a. Control Module Enclosure: Extruded aluminum.
      b. Tape: Hydrophobic with connector on each end.
      c. Tape Length: As required per plan to extend around equipment. Cable shall be field extendable.
   4. Field Power: 24-V ac or 24- to 30-V dc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 LEAK-DETECTION INSTRUMENT APPLICATION

A. Leak-detection switches (cable type).

3.03 INSTALLATION, GENERAL

A. Properly support instruments, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.

B. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force, or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

C. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.04 CONNECTIONS

A. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power connections.

3.05 INSTALLATION

A. Mount switches not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

3.06 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.07 CHECKOUT PROCEDURES

A. Check installed products before continuity tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation for applicable considerations that impact performance.

3.08 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:
   1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
   2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
   3. Equipment and procedures used for calibration shall meet instrument manufacturer's written recommendations.
   4. Provide diagnostic and test equipment for calibration and adjustment.

5. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
6. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
7. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Digital Signals:
1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

C. Switches: Calibrate switches to make or break contact at set points indicated.

3.09 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

END OF SECTION 23 0923.18

SECTION 23 0923.27

TEMPERATURE INSTRUMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Thermostats

1.03 DEFINITIONS

A. HART (Highway Addressable Remote Transducer) Protocol: The global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bidirectional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.

B. RTD: Resistance temperature detector.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:
   1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
   3. Product description with complete technical data, performance curves, and product specification sheets.
   4. Installation operation and maintenance instructions, including factors affecting performance.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of product assemblies. Indicate dimensions, weights, loads, and 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. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

C. Samples: For each exposed product installed in finished space.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation 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. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.

B. Product Certificates: For each product requiring a certificate.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:
   1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

2.02 Thermostats

A. General:
   1. Provide native BACnet, application specific controllers ready to connect to a BACnet MS/TP network.

B. Full color user interface:
   1. The user interface is a color display and has five push buttons. Back lighting automatically starts when any button is pushed and remains lit for 60 seconds after the last button is pushed. Through the menu driven display, an operator can do the following:
      a. Change setpoints and fan, heating, cooling modes
      b. Choose between Fahrenheit or Celsius values
      c. Set BACnet addressing
      d. Set up and commission the installation
      e. Add or change user passwords
      f. Configure any available options

C. Security
   1. Separate passwords for users and control technicians and engineers.

D. Screen Type
   1. 128 × 128 pixels
   2. Active color LCD with LED back lighting

E. Inputs and Outputs
   1. All inputs and outputs for the BACnet Thermostat are set up at the factory and do not require set up in the field.

F. Inputs
   1. Analog inputs for discharge air temperature, water supply temperature, outside air temperature, fan status, and remote temperature sensor.
      a. Sensors are automatically detected
      b. Inputs accept industry-standard 10K ohm Type II thermistor sensors
      c. Input overvoltage protection up to 24 volts AC, continuous
      d. 12-bit analog-to-digital conversion
      e. Relay outputs
      f. All relay outputs are normally open, SPST, Form “A” relays
      g. 1 Ampere maximum per relay at 24 volts AC or DC for each output. Maximum for all relay outputs is 3 amperes (72VA)

G. Analog Inputs
   1. Short-circuit protected
   2. Loads up to 10 mA at 0-12 volts DC
   3. 8-bit PWM digital-to-analog conversion

H. Connections
   1. Screw terminal blocks, wire size 14-22 AWG, for inputs, outputs, power, and network connections.

I. BACnet Communication
   1. Integral peer-to-peer BACnet MS/TP network communications

2. Network speed from 9600 to 76,800 baud
3. Front panel selection for device instance, MAC address, and baud rate
4. Meets or exceeds ANSI/ASHRAE BACnet Standard 135- 2008 for Application Specific Controllers
5. Accuracy ±0.36°F (±0.2°C)
6. Resistance 10,000Ω at 77°F (25°C)
7. Operating Range 48 to 96°F (8.8 to 35.5°C)

J. Regulatory Approval
1. UL 916 Energy Management Equipment
2. FCC Class A, Part 15, Subpart B and complies with Canadian ICES-003 Class B
3. BACnet Testing Laboratory listed
4. SASO PCP Registration KSA R-103260

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPERATURE INSTRUMENT APPLICATIONS

A. Thermostats:
1. VRF and VRV system: See specification section 238129 for thermostat requirements.

3.03 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.

C. Fastening Hardware:
1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

3.04 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install power wiring. Comply with requirements in electrical specifications "Low-Voltage Electrical Power Conductors and Cables."

3.05 TEMPERATURE INSTRUMENT INSTALLATIONS

A. Mounting Location:
1. Roughing In:

a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
    1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
    2) Do not begin installation without submittal approval of mounting location.
c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

B. Special Mounting Requirements:
1. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.

C. Mounting Height:
1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.
    a. Make every effort to mount at 60 inches.

3.06 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.07 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.08 CHECK-OUT PROCEDURES

A. Check installed products before continuity tests, leak tests, and calibration.

B. Check temperature instruments for proper location and accessibility.

C. Verify sensing element type and proper material.

D. Verify location and length.

E. Verify that wiring is correct and secure.

3.09 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:
1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.

B. Analog Signals:
1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:
1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

C. Perform the following tests and inspections:
1. Perform according to manufacturer's written instruction.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.

END OF SECTION 23 0923.27

SECTION 23 2300

REFRIGERANT PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Refrigerant pipes and fittings.
   2. Refrigerant piping valves and specialties.
   3. Refrigerants.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and piping specialty.

B. Shop Drawings:
   1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
   2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
   3. Show interface and spatial relationships between piping and equipment.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.07 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:
   1. Suction Lines for Air-Conditioning Applications: 300 psig.
   2. Suction Lines for Heat-Pump Applications: 535 psig.
   3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

2.02 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8/A5.8M.

E. Flexible Connectors:
   1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
   2. End Connections: Socket ends.
   3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
   4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
   5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.03 VALVES AND SPECIALTIES

A. Check Valves:
   1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
   2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
   3. Piston: Removable polytetrafluoroethylene seat.
   4. Closing Spring: Stainless steel.
   5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
   6. End Connections: Socket, union, threaded, or flanged.
   7. Maximum Opening Pressure: 0.50 psig.
   8. Working Pressure Rating: 500 psig.
   9. Maximum Operating Temperature: 275 deg F.

B. Service Valves:
   1. Body: Forged brass with brass cap including key end to remove core.
   2. Core: Removable ball-type check valve with stainless-steel spring.
   3. Seat: Polytetrafluoroethylene.
   4. End Connections: Copper spring.
   5. Working Pressure Rating: 500 psig.

C. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
   1. Body and Bonnet: Plated steel.
   2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
   3. Seat: Polytetrafluoroethylene.
   4. End Connections: Threaded.
   5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
   6. Working Pressure Rating: 400 psig (2760 kPa).
   7. Maximum Operating Temperature: 240 deg F (116 deg C).

2.04 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 3-1/2 (DN 90) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.02 VALVE AND SPECIALTY APPLICATIONS

A. Install valves and piping specialties as required by manufacturer.

B. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

3.03 PIPING INSTALLATION

A. 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

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 adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

N. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

P. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.04 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.05 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
   2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
   1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
   2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
   3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod, 1/4 inch (6.4 mm).
   4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
   5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
   6. NPS 2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).

D. Support multifloor vertical runs at least at each floor.

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Comply with ASME B31.5, Chapter VI.
   2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
      a. Fill system with nitrogen to the required test pressure.
      b. System shall maintain test pressure at the manifold gage throughout duration of test.
      c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
      d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.07 SYSTEM CHARGING

A. Charge system using the following procedures:
   1. Install core in filter dryers after leak test but before evacuation.
   2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
   3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
   4. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
   1. Verify that compressor oil level is correct.
   2. Open compressor suction and discharge valves.
   3. Open refrigerant valves except bypass valves that are used for other purposes.
   4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 2300

SECTION 23 3113

METAL DUCTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   3. Sheet metal materials.
   4. Sealants and gaskets.
   5. Hangers and supports.
   6. Seismic-restraint devices.
   7. Duct liner.

B. Related Sections:
   1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 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.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. And SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.
   3. Seismic-restraint devices.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top 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. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

PART 2 PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 30 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 72 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

A. General Material Requirements: 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: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.04 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. 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 (2500 Pa), 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.

C. 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.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

F. Quiet-Coat External Duct Sealant.
   1. Quietcoat 118 as manufactured by QuietRock shall be utilized as specified in section 3 in conformance with the sound consultant requirements.

2.05 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:
   1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

2.06 DUCT LINER

A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534/C 534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
   2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

B. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Knauf Insulation Atmosphere Duct Liner with Ecose Technology or approved equal.
   2. Minimum Density: 1.5 pounds per cubic foot.
   3. Antimicrobial Erosion-Resistant Coating: Surface of the liner to act as a moisture repellent surface and be erosion-resistant. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

C. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick aluminum; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. 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.
8. 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:
    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

2.07 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports an agency acceptable to authorities having jurisdiction.
    1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables: ASTM A 603, galvanized -steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Ducts shall be stored with openings covered and sealed until time of installation. If once installed an end is to remain open for a time frame longer than 48 hours the opening shall be covered and sealed with plastic sheeting.

C. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

D. Install ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.[Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to be welded. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:
   1. Ductwork shall be galvanized steel.
      a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."
   2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.04 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
   3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
   4. Unconditioned Space, Exhaust Ducts: Seal Class C.
   5. Unconditioned Space, Return-Air Ducts: Seal Class B.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.06 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." and ASCE/SEI 7.
   1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.07 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.08 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Test plans shall be submitted to architect/ engineer for approval prior at least 14 days prior to commencement.

C. Upon completion of test results shall be submitted to architect / engineer.

D. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

E. Duct system will be considered defective if it does not pass tests and inspections and will require duct cleaning.

F. Prepare test and inspection reports.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:
   1. All supply duct work:
      a. Pressure Class: Positive 2-inch wg
      b. Minimum SMACNA Seal Class: C
      c. SMACNA Leakage Class for Rectangular: 24
      d. SMACNA Leakage Class for Round and Flat Oval: 12

C. Return Ducts:
   1. All return ductwork:
      a. Pressure Class: Positive or negative 2-inch wg
      b. Minimum SMACNA Seal Class: B
      c. SMACNA Leakage Class for Rectangular: 6
      d. SMACNA Leakage Class for Round and Flat Oval: 6

D. Exhaust Ducts:
   1. General Exhaust
      a. Pressure Class: Positive or negative 2-inch wg
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 12
      d. SMACNA Leakage Class for Round and Flat Oval: 12

E. Outdoor-Air Ducts:
   1. Ducts Connected to Fan Coil Units:
      a. Pressure Class: Positive or negative inch wg.
      b. Minimum SMACNA Seal Class: B.

c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 8.

F. Liner:
1. Supply-Air Ducts: In exposed locations, Type I Flexible elastomeric 1-1/2 inch(es) thick.
2. Outside-Air Ducts: In exposed locations, Type I Flexible elastomeric 1-1/2 inch(es) thick.
3. Return-Air Ducts: In exposed locations, non-lined or insulated.
4. Supply and Return-Air Ducts: Serving sound department areas. This includes all ductwork from any unit serving a sound pod, foley room, foley control room, sound office, sound pod equipment room or the twitch room. Fibrous glass duct liner 2 inch(es) thick.

G. Quiet-Coat Duct Seal:
1. Sealant shall be applied on all supply and return ductwork serving sound pods, sound pod equipment rooms, foley room, foley control room, sound offices, and the twitch room.
2. Two coats shall be applied.
3. Coating shall be applied to all supply and return air ductwork and plenum boxes serving these rooms.

H. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

I. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
a. Velocity 1000 fpm (5 m/s) or Lower:
1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.
b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
c. Velocity 1500 fpm (7.6 m/s) or Higher:
1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

J. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

END OF SECTION 23 3113

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Backdraft dampers.
   2. Manual volume dampers.
   3. Flange connectors.
   4. Duct silencers.
   5. Turning vanes.
   6. Remote damper operators.
   7. Duct-mounted access doors.
   8. Flexible connectors.
   9. Duct accessory hardware.

B. Related Requirements:
   1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 ASSEMBLY DESCRIPTION

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 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.

2.02 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Greenheck or Ruskin

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or mechanically attached.

F. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.

I. Blade Axles:
   1. Material: Stainless steel or Aluminum.
   2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Mounting: Front mounted in sleeve.
      a. Sleeve Thickness: 20 gage (1.0 mm) minimum.
      b. Sleeve Length: 6 inches (152 mm) minimum.
   6. 90-degree stops.

2.04 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Standard leakage rating.
   2. Suitable for horizontal or vertical applications.
   3. Frames:
      a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   4. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
   5. Blade Axles: Galvanized steel.
   6. Bearings:
      a. Molded synthetic.
      b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   7. Tie Bars and Brackets: Galvanized steel.

2.05 FLANGE CONNECTORS

A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gage and Shape: Match connecting ductwork.

2.06 DUCT SILENCERS

A. To be specified by acoustical engineer.

2.07 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall.

E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.08 REMOTE DAMPER OPERATORS

A. Young regulator

B. Description: Cable system designed for remote manual damper adjustment.

C. Cable: Steel.

D. Wall-Box Mounting: Recessed.

E. Wall-Box Cover-Plate Material: Steel.

2.09 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. Vision panel.
      d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   3. Number of Hinges and Locks:
      a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
      c. Access Doors up to 24 by 48 Inches: Three hinges Continuous and two compression latches.
      d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.10 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 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. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

F. 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 fan discharge and duct.
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. Outdoor 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 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.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Connect ducts to duct silencers rigidly.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. At outdoor-air intakes and mixed-air plenums.
2. At drain pans and seals.
3. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
4. Upstream from turning vanes.
5. Upstream or downstream from duct silencers.
6. Control devices requiring inspection.
7. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. Install duct test holes where required for testing and balancing purposes.

N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.02 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.
3. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 3300

SECTION 23 3346

FLEXIBLE DUCTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Insulated flexible ducts.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For flexible ducts.
   1. Include plans showing mounting and attachment details.

PART 2 PRODUCTS

2.01 ASSEMBLY DESCRIPTION

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 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.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.02 INSULATED FLEXIBLE DUCTS

A. Acoustical Insulated Flexible Duct: UL 181, Class 1 with:
   1. Manufacturer: Casco Silent Flex II (Model SF-181M) or Approved Equal
   2. Non-woven nylon liner with porous surface.
   3. Steel spring wire helix.
   4. Polyethylene vapor barrier jacket.
   5. Adjustable metal male/female collars.
   6. Pressure rating 1-1/2 in. positive to 1/2 in. negative.
   7. Maximum Air Velocity: 4,000 fpm (continuous).
   8. Temperature Range: 20 deg. F to 200 deg. F.

2.03 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

D. Connect flexible ducts to metal ducts with draw bands.

E. Install duct test holes where required for testing and balancing purposes.

F. Bends of flexible ducting shall not exceed a

G. Installation:
   1. Install ducts fully extended.
   2. Do not bend ducts across sharp corners.
   3. Bends of flexible ducting shall not exceed a minimum of one duct diameter or used in place of elbows.
   4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
   5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:
   1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
   2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
   3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
   4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 23 3346

SECTION 23 3416

CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes: For each product.
   1. Backward-inclined centrifugal fans.
   2. Utility Set.

1.03 ACTION SUBMITTALS

A. Product Data:
   1. Include rated capacities, furnished specialties, and accessories for each fan.
   2. Certified fan performance curves with system operating conditions indicated.
   3. Certified 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.

B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. 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.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals. Provide manufacturer recommended service intervals for all serviceable components.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: One set(s) for each belt-driven unit.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AMCA Compliance:
   1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
   2. Operating Limits: Classify according to AMCA 99.

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.

2.02 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Manufacturer
   1. Cook
   2. Greenheck
   3. Twin City Fans

B. Description

1. Fan shall be a spun aluminum, roof mounted, belt driven or direct driven as scheduled, downblast centrifugal exhaust ventilator.

C. Certifications
   1. Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (cUL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

D. Construction
   1. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength.
   2. For belt driven fan a two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting.
   3. For direct driven fans an integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from the exhaust airstream.
   4. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.

E. Wheel
   1. Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

F. Belt Driven Motor
   1. Motor shall be Nema design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.
   2. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
   3. Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
   4. Motor shall be an electronically commutated motor rated for continuous duty and furnished either with internally mounted potentiometer speed controller or with leads for connection to 0-10 VDC external controller.

2.03 UTILITY SET STEEL HOUSING

A. Manufacturer
   1. Cook
   2. Greenheck
   3. Twin City Fans

B. Description

1. Fan shall be a single width, single inlet, backward inclined flat blade, belt driven centrifugal vent set.

C. Certifications
   1. Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL/cUL 705) for US and Canada. For restaurant applications, fan shall be listed by Underwriters Laboratories (UL/cUL 762) for US and Canada. Fan shall bear the AMCA Certified Ratings Seal for Sound and Air performance.

D. Construction
   1. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The scroll wrapper shall be minimum 14 gauge steel and the scroll side panels shall be minimum 12 gauge steel. The entire fan housing shall have continuously welded seams for leakproof operation. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing. The fan housing shall be field rotatable to any one of eight discharge positions and shall have a minimum 1-1/2 inch outlet discharge flange. Bearing support shall be minimum 10 gauge welded steel. Side access inspection ports shall be provided with quick release latches for access to the motor compartment without removing the weather cover. Lifting lugs shall be provided for ease of installation. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA Certified Transit Tested Packaging.

E. Coating
   1. Steel fan components shall be LorenizedTM with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

F. Wheel
   1. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel hub shall be keyed and securely attached to the fan shaft. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

G. Motor
   1. Motor shall be NEMA Design B with Class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

H. Blower Shaft
   1. Blower shaft shall be AISI C-1045 hot rolled and accurately turned, ground and polished. Shafting shall be sized for a critical speed of at least 125% of maximum RPM.

I. Bearings
   1. Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball or roller type in a cast iron pillowblock housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

J. Belts and Drives
   1. Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

2.04 UTILITY SET ALUMINUM HOUSING

A. Manufacturer
   1. Cook
   2. Greenheck
   3. Twin City Fans

B. Description
   1. Fan shall be a single width, single inlet, backward inclined flat blade, belt driven centrifugal vent set featuring spark resistant Type A construction.

C. Certifications
   1. Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL/cUL 705) for US and Canada. For restaurant applications, fan shall be listed by Underwriters Laboratories (UL/cUL762) for US and Canada. Fan shall bear the AMCA Certified Ratings Seal for Sound and Air performance.

D. Construction
   1. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The scroll wrapper shall be minimum 0.100" aluminum and the scroll side panels shall be minimum 0.100" aluminum. The entire fan housing shall have continuously welded seams for leakproof operation. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing. The fan housing shall be field rotatable to any one of eight discharge positions and shall have a minimum 1-1/2 inch outlet discharge flange. Bearing support shall be minimum 10 gauge welded steel. Side access inspection ports shall be provided with quick release latches for access to the motor compartment without removing the weather cover. Lifting lugs shall be provided for ease of installation. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA Certified Transit Tested Packaging.

E. Coating
   1. Steel fan components shall be LorenizedTM with an electrostatically applied, baked polyester powder coating. Each powder coated component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

F. Wheel
   1. Wheel shall be aluminum centrifugal backward inclined, non- overloading flat blade type. Blades shall be continuously welded to the backplate and deep spun inlet shroud. Wheel hub shall be keyed and securely attached to the fan shaft. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

G. Motor
   1. Motor shall be NEMA Design B with Class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

H. Bearings
   1. Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball or roller type in a cast iron pillowblock housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

I. Blower Shaft
   1. Blower shaft shall be Type 316 Stainless Steel accurately turned, ground and polished. Shafting shall be sized for a critical speed of at least 125% of maximum RPM.

J. Belts and Drives
   1. Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

2.05 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.06 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/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 EXECUTION

3.01 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:
   1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

E. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction.

F. Install units with clearances for service and maintenance.

G. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections :
   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. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.04 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 23 3416

SECTION 23 3713

AIR DIFFUSERS AND GRILLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Perforated diffusers.
   2. Fixed Face Registers and Grilles.
   3. Side wall diffusers.
   4. Side walls grilles.
   5. Linear slot diffusers and grilles.
   6. Round ceiling diffusers.
   7. Louver Face diffusers.

B. Related Requirements:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   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 Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.04 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 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.

B. Source quality-control reports.

PART 2 PRODUCTS

2.01 PERFORATED DIFFUSERS

A. Manufacturers
   1. Titus
   2. Price

B. Material: Steel backpan and pattern controllers, with steel face.

C. Finish: Baked enamel, white

D. Face Size: 12 by 12 inches, 16 by 16 inches, 20 by 20 inches, 24 by 24 inches

E. Duct Inlet: Square.

F. Face Style: Flush.

G. Mounting: Surface in non-lay-in ceiling applications and T-bar in lay-in ceiling applications.

H. Pattern Controller: Adjustable with louvered pattern modules at inlet.

2.02 FIXED FACE REGISTERS AND GRILLES:

A. Manufacturers
   1. Titus
   2. Price

B. Material: Steel

C. Finish: Baked enamel, white

D. Face Arrangement: Perforated

E. Mounting: Surface in non-lay-in ceiling applications and T-bar in lay-in ceiling applications.

2.03 SIDE WALL DIFFUSERS:

A. Manufacturers
   1. Titus
   2. Price

B. Steel supply grilles shall be double deflection of the sizes and mounting types shown on the plans and outlet schedule. The deflection blades shall be available parallel to the long dimension of the grille. Construction shall be of steel with a 1¼-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.

C. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be spaced on ¾-inch centers. Blades shall have steel friction pivots on both ends to allow individual blade adjustment without loosening or rattling. Plastic blade pivots are not acceptable.

D. Opposed-blade volume damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the grille.

E. The grille finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

F. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2.04 SIDE WALL GRILLES:

A. Manufacturers
   1. Titus
   2. Price

B. General Description: Steel return grilles shall have ¾-inch blade spacing of the sizes and mounting types shown on the plans and outlet schedule. The fixed deflection blades shall be available parallel to the long or short dimension of the grille. Construction shall be of steel with a 1¼-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.

C. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed to the grille by welding in place. Blade deflection angle shall be available at 35°.

D. The grille finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315° F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film.

E. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

2.05 ROUND CEILING DIFFUSERS:

A. Manufacturers
   1. Titus
   2. Price

B. The diffuser shall have four cones and round neck inlets of the sizes and mounting types shown on the plans and outlet schedule. Round diffusers shall be constructed of 18-gauge steel. The airflow discharge pattern shall be field adjustable from horizontal to vertical by extending or retracting the inner three cones. These three cones shall be constructed as a single inner assembly and must be easily removable using a spring lock mechanism. Vertical to horizontal discharge pattern must be achieved by rotating the center cone clockwise or counterclockwise to move the cones up or down.

C. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H.

D. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

2.06 LOUVER FACE DIFFUSERS

A. Manufacturer
   1. Titus
   2. Price

B. Material: Steel.

C. Finish: Baked enamel, white.

D. Face Size: 24” x 24”.

E. Mounting: T-bar.

F. Pattern: Adjustable core style.

G. Accessories:
   1. Square to round neck adaptor.
   2. Adjustable pattern vanes.
   3. Sectorizing baffles.

2.07 LINEAR SLOT DIFFUSERS

A. Manufacturer
   1. Titus
   2. Price

B. Material - Shell: Steel.

C. Material - Pattern Controller and Tees: Aluminum.

D. Finish - Face and Shell: Baked enamel, white.

E. Finish - Pattern Controller: Baked enamel, black.

2.08 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers are 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.

3.02 INSTALLATION

A. Install diffusers 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 practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers and grilleswith airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 3713

SECTION 23 7416

PACKAGED, ROOFTOP AIR-CONDITIONING UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes packaged, small-capacity, rooftop air-conditioning units (RTUs) with the following components and accessories:
   1. Casings.
   2. Fans.
   3. Motors.
   4. Coils.
   5. Refrigerant circuit components.
   6. Air filtration.
   7. Dampers.
   8. Electrical power connections.
   9. Controls.
   10. Accessories.
   11. Roof curbs.

1.03 DEFINITIONS

A. DDC: Direct digital controls.

B. ECM: Electronically commutated motor.

C. MERV: Minimum efficiency reporting value.

D. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, small-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.04 ACTION SUBMITTALS

A. Product Data: For each RTU.
   1. Include manufacturer's technical data.
   2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU 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 curb to roof structure. Indicate coordinating requirements with roof membrane system.

1.05 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force 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.

B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals. Provide schedule for manufacturer’s recommended service intervals for all serviceable components.

1.07 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. Fan Belts: One set(s) for each belt-driven fan.
   2. Filters: One set(s) of filters for each unit.

1.08 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three from date of Substantial Completion.

PART 2 PRODUCTS

2.01 DESCRIPTION

A. AHRI Compliance:
   1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.
   2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
   3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
   4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.

B. AMCA Compliance:
   1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
   2. Damper leakage tested according to AMCA 500-D.
   3. Operating Limits: Classify according to AMCA 99.

C. 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, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES Compliance: Comply with applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. NFPA Compliance: Comply with NFPA 90A or NFPA 90B.

F. UL Compliance: Comply with UL 1995.

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.

2.02 MANUFACTURERS

A. Daikin

B. Trane

C. Carrier

2.03 GENERAL

A. All 3 - 12½ ton units are designed for convertible airflow orientation to serve downflow or horizontal applications.

B. All units are charged with R-410A refrigerant and run-tested at the factory to check modes of operation and proper fan rotation.

C. All units are rated in accordance with AHRI Standards 210/240 or 340/360.

D. Units are ETL listed and certified under US and Canadian standards of safety requirements.

2.04 WARRANTY

A. Units feature a 5-year parts and compressor warranty. Gas heat exchangers in gas/electric units include a 20-year warranty. Complete warranty information is available from your local dealer or at www.daikincomfort.com.

2.05 CABINET

A. Unit cabinets are made with galvanized steel with a powder-paint finish. Service panels provide access to refrigeration, heating, blower, controls and filter sections. Interior surfaces in the indoor air section is insulated with ½" thick foil-faced insulation. Units have a condensate drain pan with both vertical and horizontal drain connections. Base rails are a minimum 3½" tall and include holes to allow for overhead rigging and lifting with forklifts.

2.06 CONTROLS

A. Units are factory-wired with color-coded wires with all necessary 24-volt electro-mechanical controls.

B. Units have single-point power entry either with the unit or with the electrical heat kits.

C. Units come with a grounding lug as standard.

2.07 COMPRESSORS

A. Compressors are scroll compressors with internal overload protection. On units with two refrigeration circuits (7½ - 25 tons), one scroll compressor is used on each circuit.

2.08 REFRIGERATION

A. All units have hermetically sealed scroll compressors with internal overload protection. Compressors are factory-mounted on rubber grommets.

B. Coils are made of internally finned copper tube mechanically bonded to aluminum plate fins. Coils are pressure tested at the factory to ensure pressure and leak integrity. The evaporator coil and condenser coil are leak-tested to 575 psig and pressure-tested to 450 psig. For 25 tons, microchannel evaporator coils are tested to 700 psig.

C. Each refrigerant circuit has a fixed orifice-metering device. 7½ - 25 ton units have two refrigerant circuits. 3 - 6 ton units have a single refrigerant circuit. Evaporator and condenser coils are qualified to UL 1995 burst test to 2,200 psi. Units include high- and low-pressure switches, service ports, and factory-installed filter driers. All heat pump units (DSH/DCH/DTH units) use a refrigerant accumulator.

D. Condenser coil to be [provided with DDC Green LV coating.

2.09 FANS

A. Fans in 3-phase equipment in 3 - 5 ton units are available with direct-drive, multi-speed motors or belt-drive motors with an adjustable-pitch motor pulley. All units 6 tons and larger come standard with belt-drive motors and adjustable-pitch motor pulleys. Fans in 1-phase equipment in 3 - 5 ton units are available with direct-drive motors. All motors are thermally protected. All evaporator blowers consist of double-inlet type, dynamically balanced forward curved fan wheels. All belted blower motors incorporate an adjustable belt tension mechanism that requires only a single wrench. Outdoor condenser fans are direct-drive, permanently lubricated, and contain overload protection.

2.10 FILTRATION

A. Two-inch filters are standard on all units.

2.11 COOLING OPERATION RANGE OF OUTDOOR AMBIENT TEMPERATURE

A. The cooling operating range is between 115°F and 35°F outdoor ambient temperature for 7½ - 20 ton units and between 115°F and 60°F outdoor ambient temperature for 3- to 6-ton units as standard from the factory.

2.12 ACCESSORIES AND OPTIONS

A. Not all accessories and options are available for all units.

2.13 FACTORY-INSTALLED OPTIONS

A. Return Air and/or Supply Air Smoke Detectors: Supply air smoke detectors to be installed in the unit.

B. Disconnect Switch (non-fused): A disconnect switch can be installed in the unit with factory wiring complete from the switch to the unit. Please note that for air conditioners (DSC/DCC/DTC units) and heat pumps (DSH/DCH/DTH units), the appropriate electric heat kit must be ordered along with the disconnect switch (non-fused) to be factory-installed. For models with a powered convenience outlet option and a disconnect switch (non-fused) option, the power to the powered convenience outlet will be shut off when the disconnect switch (non-fused) is in the off position.

C. Two-speed indoor fan blower: Two-speed indoor fan blower models are available on 6 - 25 ton ton units. Section

D. 6.4.3.10.b of ASHRAE Standard 90.1-2010 and Section 6.5.3.2.1.a of ASHRAE Standard 90.1-2013 require a minimum of two fan speeds. Section 140.4(m)1 of California Energy Commission Title 24-2013 contains a similar provision. When the units with the two-speed indoor fan blowers operate on a call for the first stage of cooling, the fan operates at low speed, which is 66% of full speed. When the units operate on a call for the second stage of cooling, the fan operates at full speed. In heating operation, the fan operates at full speed.

E. Phase Monitor: Phase monitor (3 phase only), available for 3 - 25 ton DS, DC and DT series models. Phase monitor shall provide protection for motors and compressors against problems caused by phase loss, phase reversal and phase unbalance. Phase monitor is equipped with an LED that provides an ON or FAULT indicator.

F. DDC Controller: DDC communicating controller, available for 3 - 25 ton DS, DC and DT series models with on-board BACnet® communication interface.

G. Hinged Access Panels: Allows access to unit's major components. Combined with latches for easy access to control box, compressor, filters and blower motor. Available on 3 - 25 Tons units.

2.14 FIELD-INSTALLED OPTIONS

A. Economizer: Fully modulating between 0 and 100%. Includes motor and dampers, minimum position settings, preset linkage, wiring harness with plug, mixed air temperature sensor, and enthalpy control. An optional duct-mounted barometric relief damper is available. An optional return enthalpy sensor is available to provide comparative or differential enthalpy control.

B. Power Exhaust: This accessory exhausts return air and may be used in either downflow or horizontal (duct-mounted) applications.

C. Provide pre-manufactured insulated roof curb.
   1. Pre-fabricated roof curbs to be of prime galvanized steel construction, 14, 16, 18 or 20 gauge as required, meeting ASTM A653/653M, with welded corners and 3” cant fully mitered with seams joined by continuous welds. Curbs to be internally reinforced, factory insulated with 1 ½” thick 3 lbs. density fiberglass insulation, and factory installed wood nailers fastened from underside with Tek screws. Height to be 8” above roof deck. Top of all roof curbs shall be level, with pitch built into curb when deck slopes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

C. Equipment Mounting:
   1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.03 CONNECTIONS

A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
   4. Install return-air duct continuously through roof structure.

B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

C. Where installing piping adjacent to RTUs, allow space for service and maintenance.

D. Connect electrical wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Locate nameplate where easily visible.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   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.

D. RTU will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.05 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Inspect for visible damage to unit casing.
   3. Inspect for visible damage to compressor, coils, and fans.
   4. Inspect internal insulation.
   5. Verify that labels are clearly visible.
   6. Verify that clearances have been provided for servicing.
   7. Verify that controls are connected and operable.
   8. Verify that filters are installed.
   9. Clean condenser coil and inspect for construction debris.
   10. Remove packing from vibration isolators.
   11. Inspect operation of barometric relief dampers.
   12. Verify lubrication on fan and motor bearings.
   13. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   14. Adjust fan belts to proper alignment and tension.
   15. Start unit according to manufacturer's written instructions.
       a. Start refrigeration system.
       b. Do not operate below recommended low-ambient temperature.
       c. Complete startup sheets and attach copy with Contractor's startup report.
   16. Inspect and record performance of interlocks and protective devices; verify sequences.
   17. Operate unit for an initial period as recommended or required by manufacturer.
   18. Calibrate thermostats.
   19. Adjust and inspect high-temperature limits.
   20. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
   21. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) above return-air temperature:
       a. Coil leaving-air, dry- and wet-bulb temperatures.
       b. Coil entering-air, dry- and wet-bulb temperatures.
       c. Outdoor-air, dry-bulb temperature.
       d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
   22. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
   23. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
       a. Supply-air volume.
       b. Return-air volume.
       c. Relief-air volume.

d. Outdoor-air intake volume.

24. Simulate maximum cooling demand and inspect the following:
    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
25. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    a. Low-temperature safety operation.
    b. Filter high-pressure differential alarm.
    c. Economizer to minimum outdoor-air changeover.
    d. Relief-air fan operation.
    e. Smoke and firestat alarms.
26. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.06 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 23 7416

SECTION 23 7433

DEDICATED OUTDOOR-AIR UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Prepare the following by or under the supervision of a qualified professional engineer:
      a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
      b. Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals. Provide manufacturer recommended service intervals for all serviceable components.

1.05 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. Fan Belts: One set[s] for each belt-driven fan.
   2. Filters: One set[s] for each unit.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cook

B. Greenheck

C. Twin City Fan

2.02 DESCRIPTION

A. Fan shall be a roof mounted, belt driven, filtered, double width, double inlet centrifugal supply blower with tiered aluminum hood.

2.03 CERTIFICATIONS

A. Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL/cUL 705) for US and Canada.

2.04 CONSTRUCTION

A. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The louvered hood shall be constructed of extruded aluminum with continuously welded and mitered corners. The removable topcap shall be constructed of minimum 0.064 aluminum.

Filters shall be washable expanded aluminum media with two inch formed aluminum frame The aluminum curb cap shall have continuously welded corners. The internal blower scroll wrapper and scroll side panels shall be a minimum 12 gauge steel and shall have continuously welded seams for leakproof operation. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing. Bearing support shall be minimum 1/4" welded steel. Lifting lugs shall be provided for ease of installation. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.

2.05 COATING

A. Steel fan components shall be Lorenized™ with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

2.06 WHEEL

A. Wheel shall be steel, non-overloading, centrifugal backward inclined, airfoil type. Blades on all sizes shall be continuously welded to the backplate and deep spun inlet shroud. Hubs shall be keyed and securely attached to the fan shaft. Wheel shall overlap aerodynamic aluminum inlet cones to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204- 05, Balance Quality and Vibration Levels for Fans.

2.07 MOTOR

A. Motor shall be Nema design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

2.08 BLOWER SHAFT

A. Blower shaft shall be AISI C-1045 hot rolled and accurately turned, ground and polished. Shafting shall be sized for a critical speed of at least 125% of maximum RPM.

2.09 BEARINGS

A. Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball or roller type in a cast iron pillow block housing and selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

2.10 BELTS AND DRIVES

A. Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

2.11 PRODUCT

A. Fan shall be model CFS as manufactured by Loren Cook Company of Springfield, Missouri.

PART 3 EXECUTION

3.01 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 piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
   1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
   2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
   3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

C. Equipment Mounting:
   1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

D. Install separate devices furnished by manufacturer and not factory installed.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.03 CONNECTIONS

A. Duct Connections:
   1. Comply with requirements in Section 233113 "Metal Ducts."
   2. Drawings indicate the general arrangement of ducts.
   3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

B. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
   1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.04 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Inspect casing insulation for integrity, moisture content, and adhesion.
   3. Verify that clearances have been provided for servicing.
   4. Verify that controls are connected and operable.
   5. Verify that filters are installed.
   6. Inspect and adjust vibration isolators and seismic restraints.
   7. Verify bearing lubrication.
   8. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   9. Adjust fan belts to proper alignment and tension.
   10. Start unit.
   11. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
   12. Operate unit for run-in period.
   13. Calibrate controls.
   14. Adjust and inspect high-temperature limits.
   15. Inspect outdoor-air dampers for proper stroke.
   16. Verify operational sequence of controls.
   17. Measure and record the fan airflows. Plot fan volumes on fan curve.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 7433

SECTION 23 8123.12

LARGE CAPACITY (7 TONS (25 KW) AND LARGER), COMPUTER-ROOM AIR-CONDITIONERS, FLOOR-MOUNTED UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes floor-mounted, computer-room air conditioners of 7 tons (25 kW) and larger.

1.03 DEFINITIONS

A. COP: Coefficient of performance.

B. EER: Energy efficiency ratio.

C. SCR: Silicon controlled rectifier.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include material descriptions, dimensions of individual components and profiles, and finishes for computer-room air-conditioning units.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For computer-room air conditioners.
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. 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.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals. Provide manufacturer recommended service intervals for all serviceable components.

1.06 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. Filters: One set(s) of filters for each unit.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Liebert

2.02 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.

B. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

2.03 PRODUCT

A. FRAME
   1. The frame shall be welded, formed sheet metal. It shall be protected against corrosion using the autophoretic coating process. The frame shall be capable of being separated into three parts in the field to accommodate rigging through small spaces.
      a. Downflow Air-supply Configurations
         1) The supply air shall exit from the front of the unit.
      b. Downflow Air Return
         1) The return air shall enter the unit from the top.
      c. Exterior Panels
         1) The exterior panels shall be insulated with a minimum 1 in. (25mm), 1.5 lb. (0.68 kg) density fiber insulation. The main front panel shall have captive quarter-turn fasteners

B. FILTERS—DA050, DA080
   1. For Downflow units, the filter chamber shall be located within the cabinet, and filters shall be removable from the top of the unit.
      a. Filters, 4 in. MERV 8
         1) Filters shall be deep-pleated, 4 in. (102 mm) filters with an ASHRAE 52.2-2007 MERV8 rating.
      b. Extra Filter Set
         1) 1 extra set of filters shall be provided per system.

C. LOCKING DISCONNECT SWITCH
   1. The manual disconnect switch shall be mounted in the high-voltage section of the electrical panel. The switch shall be accessible from the outside of the unit with the door closed and shall prevent access to the high-voltage electrical components until switched to the “OFF” position.

D. SHORT-CIRCUIT CURRENT RATING (SCCR)
   1. The electrical panel shall provide at least 65,000A SCCR (60 Hz).
   2. Short-circuit current rating (SCCR) is the maximum short-circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.

E. FAN SECTION
   1. Electronically Commutated (EC) Fans
      a. The fans shall be plug/plenum type, motorized impellers, single inlet and dynamically balanced. The drive package shall be direct drive, electronically commutated and variable speed. The fans shall be located to draw air over the coil to ensure even air distribution and maximum coil performance. EC fans shall be capable of being lowered into a raised floor (during field installation with EC-fan lowering jack) with minimum height of 24 in. (609.6 mm). EC fans shall also be capable of operating within the cooling cabinet, instead of under the floor.
      b. The EC fans shall be available on upflow models and fans shall operate outside the unit in a factory-provided plenum with a minimum height of 24 in (610 mm).

1) Downflow DA050 fan motor(s) shall be nominal 3.7 hp (2.8 kW) each with a maximum operating speed of 1400 rpm; quantity, 1.
2) Downflow DA080 fan motors shall be nominal 3.1 hp (4.15 kW) each with a maximum operating speed of 1520 rpm; quantity, 2.

F. REFRIGERATION SYSTEM
1. Single Circuit - DA050
a. Each unit shall include one independent refrigeration circuit and shall include a liquid-line filter drier, refrigerant sight glass with moisture indicator and electronic expansion valve. Compressor shall be located outside the air stream and shall be removable and serviceable from the front of the unit.
2. Dual Circuit - DA080
a. Each unit shall include two (2) independent refrigeration circuits and each circuit shall include liquid line filter driers, refrigerant sight glass with moisture indicator and electronic expansion valves. Compressors shall be located outside the air stream and shall be removable and serviceable from the front of the unit. Each compressor circuit shall be connected to the full-face area of the evaporator coil.

G. COMPRESSORS
1. Digital Scroll Compressors—DA050, DA080
a. The compressors shall be scroll-type with a variable capacity operation capability. Compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall have vibration isolators, thermal overloads, automatic reset high-pressure switch with lockout after three failures, rotalock service valves, suction line strainer and a maximum operating speed of 3500 rpm. The compressor motor shall be suction gas cooled.

H. CRANK-CASE HEATERS
1. The compressors shall include crankcase heaters, powered from the indoor unit electric panel.

I. EVAPORATOR COIL
1. The evaporator coil shall be A-frame design for downflow units. It shall be constructed of rifled copper tubes and aluminum fins. A stainless steel condensate drain pan shall be provided.
a. R-410A Refrigerant
1) The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase-out of HCFC refrigerants. Refrigerant shall be field supplied and field charged by the installing contractor.

J. AIR-COOLED SYSTEMS
1. The indoor evaporator unit shall include refrigerant piping and shall have a factory holding charge of nitrogen. The hot-gas and liquid lines shall be spun shut and each shall include a factory-installed Schrader valve. Field-relief of the Schrader valve shall indicate a leak-free system from the factory. Installing contractor shall cut the evaporator piping and shall evacuate and charge the system. Refrigerant shall be supplied by the installing contractor.

2.04 CONTROLS

A. LIEBERT ICOM™ MICROPROCESSOR CONTROL WITH 9 IN COLOR TOUCHSCREEN
1. The Liebert iCOM shall be microprocessor-based with a 9 in. color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the front panel is open or closed. The controls shall be menu-driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep

mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode.

a. Password Protection—The Liebert iCOM shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature allows the user to see applicable information based on the login used.
b. Unit Backup and Restore—The user shall be able to create safe copies of important control parameters. The Liebert iCOM shall have the capacity for the user to automatically backup unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup.
c. Parameter Download—The Liebert iCOM shall enable the user to download a report that lists parameter names, factory default settings and user-programmed settings in .csv format for remote reference.
d. Parameter Search—The Liebert iCOM shall have search fields for efficient navigation and parameter lookup.
e. Setup Wizards—The Liebert iCOM shall contain step-by-step tutorials or wizards to provide easy setup of the control.
f. Context-Sensitive Help—The Liebert iCOM shall have an on-board help database. The database shall provide context sensitive help to assist with setup and navigation of the menus.
g. Display Setup—The user shall have the ability to configure the Liebert iCOM information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, back-light timer and the hide/show of certain readouts shall be configurable through the display.
h. Additional Readouts—The Liebert iCOM shall permit the user to configure custom widgets on the main screen. Widget options shall include items such as fan speed, call for cooling, call for free-cooling, maintenance status, call for hot water reheat, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure, fluid flow rate and cooling capacity.
i. Status LED’s—The Liebert iCOM shall provide the user with the unit's operating status using an integrated LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.
j. Event Log—The Liebert iCOM shall automatically store the last 400 unit-only events (messages, warnings, and alarms).
k. Service Contact Information—The Liebert iCOM shall have the ability to store the local service or sales contact information.
l. Upgradeable—Liebert iCOM upgrades shall be performed through a USB connection.
m. Timers/Sleep Mode—The menu shall allow various customer settings for turning the unit On or Off.
n. Menu Layout—The menus shall be divided into two main menus: User and Service. The User screen shall contain the menus to access parameters required for basic unit control and setup. The Service screen shall be designed for service personnel and shall provide access to advanced control setup features and diagnostic information.
o. Sensor Calibration—The menus shall allow unit sensors to be calibrated with external sensors.
p. Maintenance/Wellness Settings - The menus shall allow reporting of potential component problems before they occur.
q. Options Setup—The menus shall provide operation settings for the installed components.
r. Auxiliary Boards—The menus shall allow setup of optional expansion boards.

s. Various Sensors—The menus shall allow setup and display of optional custom sensors. The control shall include four customer-accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display. When configuring the analog inputs, the selectable items to choose shall include air pressure, fluid pressure, temperature, percentage, general amperage, condenser amps, compressor amps, reheat amps, humidifier amps, unit amps, fan amps factory standard, and not used.

t. Diagnostics/Service Mode—The Liebert iCOM™ control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

B. ALARMS

1. All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated to the customer's Building Management System/Building Automation System. The Liebert iCOM control shall activate an audible and visual alarm in the event of any of the following conditions:
   a. High Temperature
   b. Low Temperature
   c. High Humidity
   d. Low Humidity
   e. EC Fan Fault
   f. Change Filters
   g. Loss of Air Flow
   h. Loss of Power
   i. Compressor Overload
   j. High Head Pressure
   k. Low Suction Pressure
   l. Custom Alarms
2. Custom alarm inputs shall be provided to indicate facility-specific events. Custom alarms can be identified with programmable labels. Frequently used alarm inputs shall include:
   a. Leak Under Floor
   b. Smoke Detected
   c. Standby Unit On
3. Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm and programmed for a time delay of 0 to 255 seconds.

C. LIEBERT ICOM™ CONTROL METHODS AND OPTIONS

1. The Liebert iCOM shall be factory-set to allow precise monitoring and control of the condition of the air entering and leaving the unit. This control shall include predictive methods to control air flow and cooling capacity based control sensors installed. Proportional and Tunable PID shall also be user-selectable options.
   a. Controlling Sensor Options
      1) The Liebert iCOM shall be flexible in the sense that it shall allow for controlling the capacity and fan from multiple different sensor selections. The sensor selections shall be:
         a) Cooling Capacity
            i. Supply
         b) Fan Speed

i. Remote

b. Temperature Compensation
   1) The Liebert iCOM™ shall be able to adjust the capacity output based on supply and return temperature conditions to meet SLA guidelines while operating at highest efficiency.

c. Humidity Control
   1) Dew point and relative humidity control methods shall be available (based on user preference) for humidity control within the conditioned space.

D. MULTI-UNIT COORDINATION
   1. Liebert iCOM teamwork shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork allows the control to optimize a group of connected cooling units with Liebert iCOM using the U2U (Unit-to-Unit) network. There shall be two modes of teamwork operation:
      a. Teamwork Mode 3 - Optimized Aisle (Optimized Aisle): May be employed in large and small rooms with varying heat loads. Optimized Aisle is the most efficient teamwork mode that allows the unit to match cooling capacity with heat load. In the Optimized Aisle mode, the fans operate in parallel. Fans can be controlled exclusively by remote temperature or using static pressure with a secondary remote temperature sensor(s) as an override to ensure that the inlet rack temperature is being met. Cooling (Compressors, Economizer or EconoPhase) is controlled through unit supply-air conditions. The Liebert iCOM calculates the average or worst-case sensor reading (user-selectable) for heating, cooling humidification and dehumidification. Based on the demand within the group, units will be allowed to operate within that mode until room conditions are satisfied. This is the best form of control for a room with an unbalanced load.

E. STANDBY/LEAD-LAG
   1. The Liebert iCOM shall allow scheduled rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

F. STANDBY UNIT CASCADING
   1. The Liebert iCOM cascade option shall allow the units to turn On and Off based on heat load when utilizing Teamwork Mode 3–Optimized Aisle mode with remote temperature sensors. In Teamwork Mode 3, Cascade mode will stage units On based on the temperature and humidity readings and their deviation from setpoint. Cascade mode coordinates the fan speed dynamically to save energy and to meet the cooling demands. For instance, with a Liebert iCOM group of six units and only 50% of the heat load, the Liebert iCOM shall operate only four units at 80% fan speed and leave the other two units in standby. As the heat load increases, the Liebert iCOM shall automatically respond to the additional new load and bring on another unit, increasing the units in operation to five. As the heat load shifts up or down, the control shall meet the needs by cascading units On or putting them back into standby.

G. VIRTUAL MASTER
   1. As part of the robust architecture of the Liebert iCOM control, it shall allow for a virtual master that coordinates operation. The Virtual Master function shall provide smooth control operation if the group's communication is compromised. When the lead unit, which is in charge of component staging in teamwork, unit staging and standby rotation, becomes disconnected from the network, the Liebert iCOM shall automatically assign a virtual master. The virtual master shall assume the same responsibilities as the master until communication is restored.

H. VIRTUAL BACK-DRAFT DAMPER
   1. The Liebert iCOM shall allow the use of a virtual back-draft damper, eliminating the need for a mechanical damper. This shall allow the fans of a stand-by unit to spin slower (15% or less) to act as a damper.

I. COMPRESSOR SHORT CYCLE CONTROL
   1. Compressor short cycle control shall be available to prevent compressor short-cycling and needless compressor wear.

J. LIEBERT MC™ CONDENSER AND ECONOPHASE COMMUNICATION
   1. The Liebert iCOM shall communicate directly with the Liebert MC condenser and/or Liebert EconoPhase unit via field-supplied CANbus communication wires and via field-supplied, low-voltage interlock wires. This communication shall allow Liebert iCOM to control Liebert MC condenser/EconoPhase modes and operation and to monitor their health and alarm status.

K. WIRED SUPPLY SENSOR
   1. Each Liebert iCOM shall have one factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.

L. SYSTEM AUTO RESTART
   1. The auto restart feature shall automatically restart the system after a power failure. Time delay shall be programmable. An optional capacitive buffer may be provided for continuous control operation through a power outage.

M. SEQUENTIAL LOAD ACTIVATION
   1. On initial startup or restart after power failure, each operational load shall be sequenced with a minimum of one second delay to minimize total inrush current.

N. LOW-PRESSURE MONITORING
   1. Units shall ship standard with low-pressure transducers for monitoring individual compressor suction pressure. If the pressure falls due to loss of charge or other mechanical cause, the corresponding circuit shall shut down to prevent equipment damage. The user shall be notified of the low-pressure condition through the local display and remote monitoring.

O. WINTER START TIME DELAY
   1. An adjustable software timer shall be provided to assist with compressor starting during cold weather. When the compressor starts, the low-pressure input shall be ignored for the period set in the user-adjustable timer. Once the delay after the compressor start has elapsed, the low-pressure input should remain in the normal state. If the low pressure input does not remain in the normal state after the delay has elapsed, the circuit shall lock out on low pressure. The low-pressure alarm shall be announced on the local display and communicated to remote monitoring systems.

P. ADVANCED FREEZE PROTECTION
   1. Units shall ship standard with advanced freeze protection enabled. The advanced freeze protection shall monitor the pressure of each circuit using a transducer. The control shall interact with the fan and compressor to prevent the unit coil from freezing if circuit suction pressure drops. Applying fan speed to direct expansion systems requires limitations to avoid freezing condensate on the coil when the unit operates below 100% fan speed. Liebert iCOM's advanced freeze protection provides the ability to predict freeze conditions and correct this condition automatically by adjusting fan speed and compressor capacity. If a freeze condition is detected, the user shall be notified through the local display and remote monitoring systems.

Q. ADVANCED HIGH-PRESSURE PROTECTION
   1. When the compressor is initially activated, the system shall be monitored for a high pressure. When high pressure is detected, the control shall reduce the system discharge pressure by altering the compressor loading and the condenser fan speed, preventing circuit shut down. If the unit is unsuccessful in correcting the problem through this interaction, an alarm shall occur and the affected compressor shall be immediately locked

off. The control shall automatically re-enable the compressor when pressure returns to a safe level.

R. REFRIGERANT PRESSURE TRANSDUCER FAILURE
   1. The control shall monitor the high-side and low-side refrigerant pressure transducers. If the control senses that the transducer has failed, has been disconnected, shorted or the reading has gone out of range, the user shall be notified through the local display and remote monitoring. The corresponding circuit that the failure has occurred on shall be disabled to prevent unit damage.

S. OIL RETURN PROTECTION
   1. The control shall monitor compressor operation and staging to ensure that liquid and hot gas velocity are maintained for proper oil return to the compressor.

T. DIGITAL SCROLL HIGH-TEMPERATURE PROTECTION
   1. The control shall monitor digital scroll temperature during unit operation. A compressor temperature limit shall be imposed to help prevent damage to the compressor. If the temperature reaches the maximum temperature limit, the compressor shall be locked out for 30 minutes and an alarm shall be annunciated on the local display and through monitoring. After the initial lockout, the control shall continue to monitor compressor temperature during the off-cycle and re enable the circuit once a safe operating temperature is reached and the 30 minutes has elapsed. The control shall store the number of high-temperature trips. The number of trips shall be accessible through the local display.

U. DIGITAL SCROLL SENSOR FAILURE
   1. The control shall monitor the status of the digital scroll sensor(s). If the control senses the thermistor becomes disconnected, shorted or the reading goes out of range, the user will be notified through an event on the local display and remote monitoring.

V. COMPRESSOR SEQUENCING
   1. A user-selectable compressor sequencing parameter shall be provided and access through the local control. This sequencing parameter presents the user with three choices:
      a. Always use Compressor 1 as lead compressor.
      b. Always use Compressor 2 as lead compressor.
      c. Auto: The unit shall automatically stage compressors to keep each unit's run time within 8 hours of the other unit's run time. NOTE: The Auto setting attempts to maintain equal run times between compressors. However, the control will not turn Off a compressor to equalize run time when it is needed to control the space.
         1) First priority: If the safety timings are acceptable for only one compressor, that compressor shall be the next to be started/stopped.
         2) Second priority: If both compressors are Off, the one with fewer working hours shall be the next to start.
         3) Third priority: If both compressors are in operation, the one that has been operating longer since the last start shall be the next to be stopped.

W. COMPRESSOR HIGH- AND LOW-TEMPERATURE LIMIT PROTECTION
   1. The control shall monitor the return air to ensure that the compressor(s) are operated within the manufacturer's defined window of operation. If the return air temperature deviates from the manufacturer's window of operation, the Liebert iCOM shall automatically adjust to prevent damage to the cooling unit or reduction in its reliability.

X. COMPRESSOR RUN TIME MONITORING
   1. The control shall log these compressor statistics:
      a. Number of compressor starts
      b. Run hours
      c. Average run time
      d. Starts per day

e. Starts per day worst
f. Number of high-pressure alarms
g. Operating phase in which the high-pressure alarm occurred
h. Number of low-pressure alarms
i. Operating phase in which the low-pressure alarm occurred
j. Number of compressor overloads
k. Number of high-temperature alarms (scroll compressors)

2. The user shall have the ability to monitor compressor operating temperature and pressure from the local display to be used as a diagnostic tool.

Y. MANUAL COMPRESSOR DISABLEMENT

1. The user shall have the ability to disable compressor operation using a set of either normally-open or normally-closed dry contacts tied directly to the control or through remote monitoring. An additional enable/disable feature shall be provided to allow the user to permanently disable an individual compressor circuit for maintenance using the local display.

Z. MANUAL COMPRESSOR OPERATION

1. The user shall be able to operate each compressor manually from the local display. The user shall be able to energize refrigeration components including liquid-line solenoid valves, compressor contactors, electronic expansion valves and adjust capacity for troubleshooting or repair. The control shall monitor the compressor during manual operation and shall shut the compressor down if needed to prevent electrical or mechanical damage.

2.05 MISCELLANEOUS OPTIONS

A. SMOKE SENSOR

1. The smoke sensor shall immediately shut down the Thermal Management system and activate the alarm system when activated. The smoke sensor shall be mounted in the electrical panel with the sensing element in the return air compartment. The smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes. The smoke sensor shall include a supervision contact closure.

B. CONDENSATE PUMP, DUAL FLOAT

1. The condensate pump shall have a minimum capacity of 145 GPH (548 l/h) at 20 ft (58 kPa) head. It shall be complete with integral dual-float switches, pump-and-motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition.

C. LOW VOLTAGE TERMINAL PACKAGE

1. Factory-installed and factory-wired terminals shall be provided.
   a. Remote Shutdown Terminals - 2 additional pairs of terminals provide the customer with additional locations to remotely shut-down the unit by field-installed devices or controls.
   b. Extra Common-Alarm Contacts - 2 additional pairs of terminals provide the customer with normally-open contacts for remote indication of unit alarms.
   c. Main-Fan Auxiliary Switch - 1 set of normally-open contacts wired to the EC-fan motor contactor will close when EC-fan operation is required. This set of dry contacts could also be used to initiate air economizer operation. Air economizer and associated devices by others.
   d. Liqui-tect Shutdown - 1 pair of dry contacts for the Liqui-tect sensor signal will provide unit shut down. (Liqui-tect sensor is not included.)

D. REMOTE HUMIDIFIER CONTACT

1. A pair of N/O contacts provided for connection to a remote humidifier that allow the unit's humidity controller to control a humidifier outside the unit. Power to operate the remote humidifier does not come from the unit.

E. EC FAN OVERLOAD
   1. The EC fan fault is standard on all models.

F. COMPRESSOR OVERLOAD
   1. A pair of N/O contacts shall be factory-installed and wired to each compressor to indicate Compressor Overload.

G. QUICK RESTART FUNCTION
   1. Unit restart time for full cooling shall be 40 seconds or less after power to the unit has been restored, with fans starting within 15 seconds. The unit shall be equipped with a UPS or capacitive buffer to provide the Liebert iCOM with a minimum of 3 minutes of ride-through power. The UPS or capacitive buffer shall provide power to the Liebert IS-UNITY-DP™ card for continuous connectivity to Building Management System/Building Automation Systems (where applicable).

H. WIRED SUPPLY SENSOR
   1. A factory-installed and commissioned supply-air sensor ships with the unit for sensor location in the field by others when supply-air control is required. The sensor is terminated on the Liebert iCOM unit-controller terminal strip and the 20 ft (6 m) associated cable wiring is coiled within the unit for shipment, requiring others to locate the sensor in accordance with acceptable best practices and any local codes. The relocated supply-air temperature sensor provides real-time, direct feedback to the cooling unit, allowing the unit to adjust compressor capacity or chilled-water valve accordingly to maintain supply-air temperature setpoint. It is recommended that if relocating the supply-air sensor, that it be mounted 10 to 15 ft away from the unit directly in the discharge air stream. The supply-air temperature sensor, if left inside the unit, will provide real-time monitoring of discharge air temperature on units, such as downflow units with floor-level discharge and upflow units with discharge-grille plenums.

I. WIRED REMOTE SENSOR(S)
   1. Each Liebert iCOM™ can have up to ten 2T sensors (20 sensor readings total) for control or reference. As part of the U2U network, those sensors shall be shared and used to control the cooling units and provide greater flexibility, visibility and control to respond to changes in the conditioned space. When the sensors are used for control, the user may set the control to be based off a maximum or average of a selected highest temperature reading.

J. REMOTE MONITORING
   1. A factory-installed communication card shall be provided for monitoring and/or control. The communications card shall be capable of connecting to a Building Management System/Building Automation System using the following protocols:
      a. BACnet IP—BACnet over Internet Protocol
      b. BACnet MSTP—BACnet Master-Slave/Token-Passing (MSTP) communications protocol over a RS-485 serial network (also known as BACnet MSTP RS-485)
   2. The communication card shall be capable of connecting to two of these protocols at once.

K. RETURN AIR PLENUM FOR DOWNFLOW UNITS
   1. The air plenum shall be constructed of 20 gauge steel, powder coated to match unit color. A door shall be included in the front of the plenum to enable front filter access. Air shall enter the plenum from the top.

2.06 ECONOPHASE CYCLE

A. ECONOPHASE CYCLE
   1. During cold outdoor temperatures, refrigerant pumps shall circulate refrigerant through the cooling system, in lieu of operating the compressors. The compressors shall ramp down during EconoPhase operation, and, if able to completely offset the load, the control system shall shut the compressors off. Refrigerant pump(s) (PR050 has 1 pump, PR085-125 has 2 pumps) shall be housed in an enclosure, with each pump dedicated to its own

refrigerant circuit. The EconoPhase system shall include a variable-speed drive on each refrigerant pump to enable the pumps' speed to adjust in response to the load.

2.07 HEAT REJECTION

A. LIEBERT MC CONDENSER

1. Liebert MC Summary
   a. These specifications describe requirements for a Liebert air-cooled condenser for a Liebert Thermal Management system. The condenser shall be designed to reject waste heat to outdoor air and to control refrigerant head pressure as indoor equipment loading and outdoor ambient conditions change.
   b. The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.
   c. Standard 60 Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for "Heating and Cooling Equipment" and shall be marked with the CSA c-us logo.
2. Liebert MC Design Requirements
   a. The air-cooled condenser shall be a factory-assembled unit, complete with integral electrical panel, designed for outdoor installation. The condenser shall be a draw-through design.
3. Liebert MC Standard Features
   a. Condenser shall consist of microchannel condenser coil(s), propeller fan(s) direct-driven by individual fan motor(s), electrical controls, housing and mounting legs. The Liebert air-cooled condenser shall provide positive refrigerant head pressure control to the indoor cooling unit by adjusting heat rejection capacity. Microchannel coils shall provide superior heat transfer, reduce air-side pressure drop, increase energy efficiency and significantly reduce the system refrigerant volume required. EC fans and fan operating techniques shall reduce sound levels.
4. Liebert MC Coil
   a. Liebert MC coils shall be constructed of aluminum microchannel tubes, fins and manifolds. Tubes shall be flat and contain multiple, parallel-flow microchannels and span between aluminum headers. Full-depth louvered aluminum fins shall fill spaces between the tubes. Tubes, fins and aluminum headers shall be oven-brazed to form a complete refrigerant-to-air heat exchanger coil. Copper stub pipes shall be electric resistance-welded to aluminum coils and joints protected with polyolefin to seal joints from corrosive environmental elements. Coil assemblies shall be factory leak tested at a minimum of 300 psig (2068 kPag). Hot-gas and liquid lines shall be copper and shall be brazed using nitrogen gas flow to the stub pipes with spun-closed ends for customer piping connections. Complete coil/piping assembly shall be then filled and sealed with an inert gas holding charge for shipment.
   b. Aluminum microchannel coil with E-coat shall provide a flexible epoxy coating to all coil surface areas without material bridging between fins. E-coat shall increase coil corrosion protection and shall reduce heat rejection capacity degradation to less than 10% after a severe 2000 hour 5% neutral salt-spray test (ref. ASTM B117). The coating process shall ensure complete coil encapsulation, and the color shall be black.
5. Liebert MC Fan Motor/Blade Assembly
   a. The fan motor/blade assembly shall have an external rotor motor, fan blades and fan/finger guard. Fan blades shall be constructed of cast aluminum or glass-reinforced polymeric material. Fan guards shall be heavy gauge, close-meshed steel wire, coated with a black, corrosion-resistant finish. Fan terminal blocks shall be in an IP54 enclosure on the top of the fan motor. Fan assemblies shall be factory-balanced, tested before shipment, and mounted securely to the condenser structure.
6. Liebert MC Condenser EC Fan Motor

a. The EC-fan motors shall be electronically commutated for variable-speed operation and shall have ball bearings. The EC fans shall provide internal overload protection through built-in electronics. Each EC-fan motor shall have a built-in controller and communication module linked via RS485 communication wire to each fan and the Premium Control Board, allowing each fan to receive and respond to precise fan speed inputs from the Premium Control Board.

7. Liebert MC Electrical Controls
   a. Electrical controls and service-connection terminals shall be provided and factory-wired inside the attached control panel section. Only high-voltage supply wiring and low-voltage indoor-unit communication/interlock wiring are required at condenser installation.
      1) EC Fan Speed and Premium Control
         a) The Liebert MC EC Fan/Premium Control System shall include an electronic control board, EC fan motor(s) with internal overload protection, refrigerant and ambient temperature thermistors and refrigerant pressure transducers. The Premium Control Board shall communicate directly with the indoor unit's Liebert iCOM™ control via field supplied CANbus communication wires and via field-supplied low-voltage interlock wires. The control board shall use sensor and communication inputs to maintain refrigerant pressure by controlling each EC fan on the same refrigerant circuit to the same speed. The Premium Control Board shall be rated to a temperature of –30°F to 125°F (–34.4°C to 51.7°C) and shall be factory-set for fan speed control with Liebert DSE receivers.
         b) The mode of the Liebert MC shall be controlled by the Liebert DSE iCOM control and shall be in either DX, EconoPhase or Idle Mode by each refrigerant circuit. Dual circuit condensers shall operate fans to meet airflow needs and mode of each circuit independent of the other. Fan(s) on common refrigerant circuit shall operate in synchronous speed when that circuit is active.
      2) Locking Disconnect Switch
         a) A locking-type disconnect switch shall be factory-mounted and wired to the electrical panel and be capable of disrupting the flow of power to the unit and controlled via an externally-mounted locking and lockable door handle. The locking disconnect shall be lockable in support of lockout/tagout safety programs.
      3) Short Circuit Current Rating
         a) The electrical panel shall provide at least 65,000A SCCR.

8. Cabinet
   a. The condenser cabinet shall be constructed of bright aluminum sheet and divided into individual fan sections by full-width baffles. Internal structural support members, including coil support frame, shall be galvanized steel for strength and corrosion resistance. Panel doors shall be provided on two sides of each coil/fan section to permit coil cleaning. An electrical panel shall be contained inside a factory-mounted NEMA 3R weatherproof electrical enclosure. Units with the 575V option shall include a second, factory-mounted, NEMA 3R weatherproof electrical enclosure opposite the main electrical enclosure.

9. Liebert MC Mounting Legs Standard Aluminum Legs
   a. Standard 60 in. Height Galvanized Legs with Bracing
      1) Condenser shall be shipped with 60in. (1524mm) mounting legs with stabilization bracing. Legs, bracing and hardware shall be galvanized steel and shall be field installed and anchored to the mounting surface.

10. Liebert MC Condenser Accessories
    a. Liebert DSE™ Receiver Kit

1) Liebert DSE Receiver Kit shall contain a painted, un-insulated receiver with integral fusible plug, formed copper pipe for ease of connecting condenser liquid line to receiver and mounting bracket. Additional full length leg is shipped with condenser (18 in., 36 in. and 48 in.) or with 60 in. leg kit and should be secured to the mounting surface. One receiver kit shall be field installed per refrigerant circuit.

B. LIEBERT ECONOPHASE

1. The Liebert EconoPhase has two, variable-speed refrigerant pumps controlled by individual VFDs, factory-wired electrical panel, and factory-piped and tested refrigerant piping all housed within a bright aluminum NEMA 3R enclosure. The Liebert EconoPhase refrigerant pumps are individually activated and speed controlled during cooler outdoor ambient, coordinated with Liebert DSE compressors idled and refrigerant bypassed around them. Cool temperatures, such as mild weather and at night, partial economization, and power savings is provided with one pump activated and one compressor idled. Colder temperatures, such as winter weather, allow both Liebert DSE compressors to be idled and EconoPhase pumps to be controlled independently to provide full economization.

PART 3 EXECUTION

3.01 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 hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Layout and install computer-room air conditioners and suspension system coordinated with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Install computer-room air conditioners coordinated with computer-room access flooring Installer.

C. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

D. Computer-Room Air-Conditioner Mounting: Install using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

E. Air-Cooled Refrigerant Condenser Mounting: Install using restrained spring isolators on concrete base. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.

C. Water and Drainage Connections: Comply with applicable requirements in Section 221116 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:
   1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
   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.

D. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

F. After startup service and performance test, change filters.

3.05 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.06 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 23 8123.12

SECTION 23 8123.13

COMPUTER-ROOM AIR-CONDITIONERS, SUSPENDED UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes ceiling-mounted, computer-room air conditioners.

1.03 DEFINITIONS

A. COP: Coefficient of performance.

B. EER: Energy efficiency ratio.

C. SCR: Silicon-controlled rectifier.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include material descriptions, dimensions of individual components and profiles, and finishes for computer-room air-conditioning units.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For computer-room air conditioners.
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. 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.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals. Provide manufacturer recommended service intervals for all serviceable components.

1.06 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. Filters: One set(s) of filters for each unit.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Liebert

2.02 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.

B. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

2.03 PRODUCTS

A. Evaporator Cabinet Construction
   1. The cabinet and chassis shall be constructed of heavy gauge galvanized steel, and shall be serviceable from one side only for routine maintenance. Mounting brackets shall be integral to the cabinet design. Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 & ASTM 1338 standards.

B. Remote Sensors
   1. The unit shall be supplied with remote temperature and humidity sensors. The sensors shall be factory provided in an aesthetically pleasing housing with a 30 ft. (9m), shielded cable and shall be field mounted and field wired to the unit electrical panel.

C. Air Distribution
   1. The fan shall be plug/plenum type, with direct-drive variable speed motorized impeller, single inlet and dynamically balanced. The fans shall be located to draw air over the coil to ensure even air distribution and maximum coil performance.
   2. System shall be suitable for ducted supply and return air distribution. Supply air location shall be field selectable, configured in one of three outlet locations: back of cabinet, right side, or bottom of cabinet. The bottom supply configuration will require an additional kit (ordered and shipped separately).

D. Disconnect Switch, Non-Locking (5,000 amps SCCR)
   1. The non-automatic, non-locking, molded case circuit breaker shall be factory-mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the front of the indoor unit. The short-circuit current rating for the evaporator unit shall be 5,000 amps

E. Unit Controls, Protections and Communication Terminals
   1. The Liebert Mini-Mate shall include Liebert iCOM control with remote 9” color touchscreen display, a filter clog switch, common alarm contact and remote shutdown contacts. Filter clog switch shall be adjustable outside the cabinet and shall activate an iCOM alarm when the pressure drop across the filters exceed the customer-adjustable level. Common Alarm Contact shall be one set of normally open contacts which shall close for remote indication of alarms. Remote Shutdown Contact shall enable unit shutdown based on external input.

2.04 LIEBERT ICOM® MICROPROCESSOR CONTROL WITH REMOTE 9" COLOR TOUCHSCREEN

A. The Liebert iCOM shall be microprocessor-based with a remote 9" color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The controls shall be menu-driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes. Service menus

shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode.

1. Password Protection - The Liebert iCOM shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature allows the user to see applicable information based on the login used.
2. Unit Backup and Restore - The user shall be able to create safe copies of important control parameters. The Liebert iCOM shall have the capacity for the user to automatically backup unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup.
3. Parameter Download - The Liebert iCOM shall enable the user to download a report that lists parameter names, factory default settings and user-programmed settings in .csv format for remote reference.
4. Parameter Search - The Liebert iCOM shall have search fields for efficient navigation and parameter lookup.
5. Setup Wizards - The Liebert iCOM shall contain step-by-step tutorials or wizards to provide easy setup of the control.
6. Context-Sensitive Help - The Liebert iCOM shall have an onboard help database. The database shall provide context sensitive help to assist with setup and navigation of the menus.
7. Display Setup - The user shall have the ability to configure the Liebert iCOM information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, backlight timer and the hide/show of certain readouts shall be configurable through the display.
8. Additional Readouts - The Liebert iCOM shall permit the user to configure custom widgets on the main screen. Widget options shall include items such as fan speed, call for cooling, call for free-cooling, maintenance status, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure, fluid flow rate and cooling capacity.
9. Status LED's - The Liebert iCOM shall provide the user with the unit's operating status using an integrated LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.
10. Event Log - The Liebert iCOM shall automatically store the last 400 unit-only events (messages, warnings, and alarms).
11. Service Contact Information - The Liebert iCOM shall have the ability to store the local service or sales contact information.
12. Upgradeable - Liebert iCOM upgrades shall be performed through a USB connection.
13. Timers/Sleep Mode – The menu shall allow various customer settings for turning on/off unit.
14. Menu Layout - The menus shall be divided into two main menu screens: User and Service. The User screen shall contain the menus to access parameters required for basic unit control and setup. The Service screen shall be designed for service personal and provides access to advanced control setup features and diagnostic information.
15. Sensor Calibration – The menus shall allow unit sensors to be calibrated with external sensors.
16. Maintenance/Wellness Settings - The menus shall allow reporting of potential component problems before they occur.
17. Options Setup - The menus shall provide operation settings for the installed components.
18. Various Sensors - The menus shall allow setup and display of optional custom sensors. The control shall include four customer-accessible analog inputs for field-provided sensors. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC. The gains for each analog input shall be

programmable from the front display. The analog inputs shall be able to be monitored from the front display.

19. Diagnostics/Service Mode - The Liebert iCOM shall be provided with self-diagnostics to aid in troubleshooting. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

2.05 ALARMS

A. All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated (through optional Communication Card) to the customer's Building Management System/Building Automation System. The Liebert iCOM shall activate an audible and visual alarm in the event of any of the following conditions:
   1. High Temperature
   2. Low Temperature
   3. High Humidity
   4. Low Humidity
   5. EC Fan Fault
   6. Change Filters
   7. Loss of Air Flow
   8. Loss of Power
   9. High Water (drain pan)
   10. High Head Pressure
   11. High Discharge Temperature (Compressor)
   12. Low Suction Pressure
   13. Custom Alarms

B. Custom alarm inputs shall be provided to indicate facility-specific events. Custom alarms can be identified with programmable labels. Frequently used alarm inputs shall include:
   1. Smoke Detected (requires optional smoke sensor)
   2. Standby Unit On

C. Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm and programmed for a delay of 0 to 255 seconds.

2.06 LIEBERT ICOM® CONTROL METHODS AND OPTIONS

A. The Liebert iCOM shall be factory-set to allow precise monitoring and control of the condition of the air entering and leaving the unit. This control shall include predictive methods to control air flow and cooling capacity based control sensors installed. Proportional and Tunable PID shall also be user-selectable options.
   1. Controlling Sensor Options
      a. The Liebert iCOM shall be flexible in the sense that it shall allow controlling the capacity and fan from multiple different sensor selections. The sensor selections shall be:
         1) Cooling Capacity
            a) Return
         2) Fan Speed
            a) Return
            b) Manual (for diagnostics or to receive a signal from the BMS through Liebert remote monitoring devices or analog input)
   2. Temperature Compensation
      a. The Liebert iCOM shall have the ability to adjust the capacity output based on return temperature conditions to meet SLA guidelines while operating to highest efficiency.

2.07 MULTI-UNIT COORDINATION

A. Liebert iCOM teamwork shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork allows the control to optimize a group of connected units equipped with Liebert iCOM using the U2U (Unit-to-Unit) network. There shall be two modes of teamwork operation:
   1. Teamwork Mode 1 (Parallel): Is best in small rooms with balanced heat loads. The controlling temperature and humidity sensor readings of all units in operation (fan On) are collected to be used for an average or worst case sensor reading (user selectable). The master unit shall send the operating requirements to all operating units in the group. The control band (temperature, fan and humidity) is divided and shared among the units in the group. Each unit will receive instructions on how to operate from the Master unit based on how far the system deviates from the setpoints. Evaporator fans and cooling capacity are ramped in parallel.

2.08 STANDBY/LEAD-LAG

A. The Liebert iCOM shall allow planned rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

2.09 REMOTE MONITORING

A. All alarms shall be communicated to the Liebert® site monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity. Optional communication card is required.

2.10 DIRECT EXPANSION SYSTEM COMPONENTS

A. Indoor Evaporator Unit
   1. The evaporator section shall include evaporator coil, thermostatic expansion valve and filter drier. The evaporator coil shall have 5.6 sq.ft. (0.52 sq.m) face area, four rows deep. It shall be constructed of internally rifled copper tubes and lanced-type aluminum fins and have a maximum face velocity of 482 FPM (2.45 m/s). An externally equalized thermostatic expansion valve shall control refrigerant flow. The evaporator coil shall be factory-charged with nitrogen and sealed. The system shall be field-charged with field-supplied R-410A refrigerant.
   2. The coil assembly shall be mounted in a condensate drain pan with internally trapped drain line. The evaporator drain pan shall include a factory-installed float switch to shut down the evaporator upon high water condition.

B. Outdoor Air-Cooled Prop Fan Condensing Unit
   1. The condensing unit shall be designed for outdoor use with either roof or ground level mounting. The condensing unit is constructed of galvanized and galvaneal painted steel for corrosion resistance. Removable exterior panels shall allow access to the electric panel or refrigeration components for service or maintenance. Both inlet and outlet air grilles shall be heavy duty steel with a durable polyester coating.
   2. Condensing unit components shall include a condenser coil, a direct-drive propeller-type fan, a variable capacity Digital scroll compressor, high pressure switch, high compressor discharge temperature switch, Liebert® Lee-Temp™ insulated receiver with internal heater and head pressure control valve, and liquid line solenoid valve. The condensing coil shall be constructed of copper tubes and aluminum fins. The condenser coil shall be provided with a coated coil.
   3. High head-pressure switch shall protect the unit from abnormal refrigerant pressure conditions and shall deactivate the compressor and annunciate an alarm at the wall controller. The blower shall continue to circulate air. The wall controller shall be used to manually restart the compressor function after the automatic pressure switch resets. Four high head pressure alarms in a rolling 10-minute period or three high head pressure alarms in a rolling 12-hour period shall lock out the manual restart feature until power is cycled to the evaporator unit.

4. A pressure balancing valve shall be factory installed to reduce the chance of opening the high-pressure relief valve due to excessive refrigerant migration to the receiver due to changing outdoor temperatures during off-cycles.
5. All components shall be factory-assembled, charged with nitrogen and sealed. System shall be field-charged with field supplied R-410A refrigerant. No internal piping, brazing, or dehydration shall be required. Condensing unit shall be designed for 95°F (35°C) ambient and be capable of operation down to -30°F (-34.4°C). A high ambient condensing unit that is designed for 105°F (40.5°C) ambient is also available.

C. Digital Scroll High Temperature Protection
1. The control shall monitor digital scroll temperature during unit operation. A compressor temperature limit shall be imposed to help prevent damage to the compressor. If the temperature reaches the maximum temperature limit, the compressor shall be locked out and an alarm shall be annunciated on the local display and through remote monitoring. After the initial lockout, the control shall continue to monitor compressor temperature during the off cycle and shall re-enable the circuit once a safe operating temperature is reached (minimum 30-minute lockout). After five high discharge temperature alarms within a rolling 4-hour period the control shall lock out the compressor until power is cycled to the evaporator unit.

D. Digital Scroll Sensor Failure
1. The control shall monitor the status of the digital scroll sensor(s). If the control senses the thermistor becomes disconnected, shorted or the reading goes out of range, the user will be notified through an event on the local display and remote monitoring.

2.11 FACTORY-INSTALLED OPTIONS

A. Disconnect Switch, Locking (65,000 amps SCCR)
1. The non-automatic, locking, molded case circuit breaker shall be factory-mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the front of the indoor unit and shall have a lockable handle to support lockout/tagout safety programs. The short-circuit current rating for the evaporator unit shall be 65,000 amps.

B. Smoke Sensor
1. The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The sensing element shall sense the return air conditions. This smoke sensor shall not function or replace any room smoke detector that may be required by local or national codes.

C. IS-Unity-DP-CMS Card
1. The IS-UNITY-DP-CMS Card shall provide mobile cloud access, remote access to the unit level display via the world-wide web, and Building Management System (BMS) access via BACnet/Modbus IP and BACnet/Modbus 485. Card shall be factory-installed in the IntelliSlot card housing on outside of cabinet.
    a. Low Voltage Terminal Package
    b. Low Voltage Terminal Package includes:
    c. Two(2) additional remote input shutdown terminals
    d. Two(2) extra common alarm N/O output contacts
    e. One(1) main fan auxiliary N/O output contact
    f. One(1) remote humidifier N/O output contact
    g. One(1) Liqui-tect input terminals (Liqui-tect priced separately)

2.12 SHIP-LOOSE ACCESSORIES

A. Air Filter Box/Duct Flange
1. The evaporator section shall be supplied with an optional air filter box for use with ducted installations. Two (2) filters shall be included 4" x 20" x 20" (102 mm x 508mm x 508mm) each, pleated type, with a MERV 8 rating, based on ASHRAE 52.2-2007. A duct flange shall be supplied for use on the supply air opening of the unit.

B. Condensate Pump
   1. It shall be complete with integral float switch, pump, motor assembly, discharge check valve, duct/wall mountable bracket and reservoir. A secondary float switch shall be provided to permit field wiring to the unit control to shut down the evaporator upon a high water level condition.

C. Condensate Pump Bracket
   1. A condensate pump bracket shall be provided to mount condensate pump directly to the end of the unit, allowing for easier installation and alignment of the condensate pump.

PART 3 EXECUTION

3.01 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 hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Layout and install computer-room air conditioners and suspension system coordinated with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Install computer-room air conditioners coordinated with computer-room access flooring Installer.

C. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

D. Suspended Computer-Room Air Conditioners: Install using continuous-thread hanger rods and spring hangers of size required to support weight of computer-room air conditioner.
   1. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC." Fabricate brackets or supports as required.
   2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

E. Air-Cooled Refrigerant Condenser Mounting: Install using restrained spring isolators on concrete base. Comply with requirements for vibration isolation devices specified in [Section 230548 "Vibration and Seismic Controls for HVAC."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.

C. Water and Drainage Connections: Comply with applicable requirements in Section 221116 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Provide shutoff valves and piping.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:
   1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
   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.

D. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

F. After startup service and performance test, change filters and flush humidifier.

3.05 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.06 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 23 8123.13

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SECTION 23 8123.99

HOT AISLE CONTAINMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

1.02 SCOPE OF WORK

A. This section includes the minimum requirements for Cold Aisle Containment Systems in data center, computer rooms, and communications equipment rooms.

1.03 WARRANTY

A. The warranty specified in this article shall not deprive the Owner of rights under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the manufacturer under requirements of the Contract Documents.

B. Warranty extent: Manufacturer shall agree to repair or replace all components that fail in materials or workmanship within specified warranty period. Warranty shall include all labor, material, and related expenses to restore system and/or components from failures.

C. Warranty period: One year, unless otherwise noted. Warranty period commences upon completion of startup and successful integrated commissioning.

1.04 SUBMITTALS

A. Provide product data for the following:
   1. Manufacturer's specifications and installation instructions for all products (submit with bid).

PART 2 PRODUCTS

2.01 CONTAINMENT SYSTEM

A. Hold Aisle Containment System
   1. (HACS) Provide required components to contain the hot aisle between two rows of server cabinets. HACS shall be "rack agnostic", and will retain the ability to interface with any server cabinet manufacturer. The HACS for each aisle shall include two Aisle End Door systems (AEDS) to seal to either end of the cold aisle. Floor panels or vinyl shall be placed in the event of missing cabinets to retain containment integrity. Vinyl Partitions will be placed around the perimeter of the Hot Aisle to form a return air plenum up to the ceiling.
   2. Aisle End Door System
      a. The AEDS shall be dual sliding in operation for full pods.
      b. The AEDS shall be single sliding in operation for pods against a wall.
      c. Door and frames shall be aluminum extrusion.
      d. Door frame shall be ordered to size, typically based off the tallest server cabinet in the aisle.
      e. Sliding doors will operate using roller bearing wheels.
      f. The panel inserts for both the frame and doors shall be a translucent plastic material.
      g. Door shall have an auto closing mechanism that operates via pull-spring, and will be rated for 1million cycles.
      h. A hold open latch/detent option shall be standard on sliding doors.
      i. Doors shall include a dampening "soft close" feature.
      j. There shall be no threshold while the door is opened.
      k. Doors shall attach to the top of the cabinet with flat or angled brackets, and will attach to the floor using angle brackets and/or anchors.
   3. Vinyl Partitions

a. Vinyl partitions shall be provided that hang from the ceiling to the top of the server cabinets.
b. Vinyl shall be mounted to an aluminum extruded track (2.00” x .72” W) that is suspended in compliance with all applicable structural codes.
c. Aluminum track shall be mounted to the ceiling with a clip every 4’.
d. Vinyl partitions shall be trimmed around existing ladder rack and obstructions.

4. Panels
   a. Floor mount panels shall be used for missing server cabinets and uneven aisle lengths.
   b. Panels shall be an aluminum frame with a translucent plastic material.
   c. Panels shall connect to one another, AEDS, and the overhead ceiling modularly.
5. Material
   a. The panel frames and doors shall be aluminum extrusion.
   b. The sliding doors shall use roller wheels to open and close.
   c. The panel inserts for both the frame and doors shall be a translucent plastic material.
   d. Vinyl Partitions shall be made out of PVC that meets NFPA701.
6. Color/Finish, The aluminum components shall be clear or black anodized.
7. Containment Performance, the HACS shall be designed to provide containment integrity, with a maximum leakage of no more than 5%.
8. Approved Manufacturers: Subzero Engineering

PART 3 EXECUTION

3.01 INSTALLATION

A. Hot Aisle Containment System
   1. Manufacturer to provide all components of the HACS. This includes but is not limited to: Aisle end door systems, overhead ceiling, and floor and over rack mount panel. Hardware to install these items shall be included, depending on the environment, additional hardware may be required that is not included.
   2. Install aisle end door systems using the manufacturer’s installation instructions. Doors shall attach to the top of the cabinet with flat or angled brackets, and will attach to the floor using angle brackets and/or anchors. Additional installation hardware may be required.
   3. Install overhead ceiling and floor and over rack panels using the manufacturer’s installation instructions. Additional installation hardware may be required.

END OF SECTION 23 8123.99

SECTION 23 8126

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals. Provide schedule of manufacturer’s recommended service intervals of all serviceable components.

1.06 QUALITY ASSURANCE

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.

B. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.07 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:

a. For Compressor: Seven years from date of Substantial Completion.
b. For Parts: Five years from date of Substantial Completion.
c. For Labor: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daikin

B. Mitsubishi

C. LG

2.02 INDOOR UNITS

A. General:
1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board, fan and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function after power interruption. Indoor unit shall be purged with dry air before shipment from factory.

B. Unit Cabinet:
1. The casing shall have a smooth front, white finish – Munsell 1.0Y 9.2/0.2.
2. Multi directional drain connection and refrigerant piping, offering three (3) direction pipe alignments for all refrigerant piping and two (2) direction pipe alignments for condensate draining shall be standard.
3. There shall be a separate, metal installation-plate that secures the indoor unit firmly to the wall. The installation-plate shall be securely attached to the wall using appropriate anchor method. Installing contractor shall determine the best method and be responsible for proper mounting of the installation plate to the wall.

C. Fan:
1. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
2. The fan shall be statically and dynamically balanced and be powered by a motor with permanently lubricated bearing.
3. A manual adjustable guide vanes shall be provided with the ability to change the airflow from side to side (left to right).
4. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down. Four (4) or more positions plus Auto and Swing shall be provided, controlled from the remote controller.
5. The indoor fan shall operate at one of a minimum of 4 speeds

D. Filter:
1. Return air shall be filtered by means of easily removed, washable, Nano Platinum filter, Deodorizing-filter and an Anti-allergy enzyme filter – blue, pleated type.

E. Coil:
1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner groves for high efficiency heat exchange.
3. All tube joints shall be brazed with phoscopper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.

F. Electrical:
1. The system shall be equipped with A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 ga. AWG connections plus ground.
2. The indoor unit shall not have any supplemental electrical heat elements.

2.03 OUTDOOR UNITS

A. General: The outdoor units are specifically designed to work with the MSZ indoor units. The outdoor units must have a thermally fused powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

B. Unit Cabinet:
   1. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.
   2. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes.

C. Fan:
   1. The unit shall be furnished with a direct drive propeller type fan.
   2. The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearings.
   3. The fan motor shall be mounted for quiet operation.
   4. The fan shall be provided with a raised guard to prevent contact with moving parts.
   5. The outdoor unit shall have horizontal discharge airflow.

D. Coil:
   1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. Coil shall be provided with a corrosion resistant coating equivalent to Wilsenergy “Energy Guard DDC Green”.
   2. The coil shall be protected with an integral metal guard.
   3. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.
   4. Outdoor unit shall be pre-charged with sufficient R-410a refrigerant for up to thirty three (33) feet of refrigerant piping.
   5. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1” thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.
   6. All refrigerant connections between outdoor and indoor units shall be flare type.

E. Compressor:
   1. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type.
   2. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.
   3. The outdoor unit shall be equipped with an accumulator.
   4. The compressor will be equipped with internal thermal overload protection.
   5. The outdoor unit must have the ability to operate over the full capacity range with a maximum height difference of 40 feet and have refrigerant tubing length of 65 feet for capacities up to 15,000 BTU/h and a maximum height difference of 50 feet and have refrigerant tubing length of 100 feet for capacities above 15,000 BTU/h between indoor and outdoor units.
   6. There shall be no need for line size changes. Filters, sight glasses, and traps shall not be used, and no additional refrigerant oil shall be required.
   7. The compressor shall be mounted so as to avoid the transmission of vibration.

F. Electrical:

1. The outdoor unit electrical power supply shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.
3. The outdoor unit shall be controlled by microprocessors located in the indoor unit and outdoor unit. A 12 to 24 volt DC data stream shall communicate between the units providing all necessary information for full function control.

2.04 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan with controller to tie into BMS.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

D. Drain Hose: For condensate.

E. BMS Interface: Provide thermostat interface or similar manufacture recommended accessory to allow BACnet communication with Building Management System. Provide required manufacturer transformer to power interface controller or accessory.

F. Provide integral manufacturer recommended condensate pump. Condensate pump shall be of matching color and appearance to unit and install tight to main body of fan coil. Condensate pump shall be powered from fan coil unit per manufacturer’s guidelines.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:
   1. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.03 FIELD QUALITY CONTROL

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. 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 motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 8126

SECTION 23 8129

VARIABLE REFRIGERANT VOLUME/FLOW SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Indoor Fan Coil Units and Energy Recovery Ventilators
   2. Outdoor Condensing Units (Heat Pump and/or Heat Recovery)
   3. Branch Selector Boxes (Heat Recovery Systems)
   4. Controls
   5. Refrigerant Piping
   6. Mounting Hardware

B. Related Documents: The Contract Documents, as defined in Division 01 Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents. Comply with applicable Standards/Codes ANSI/ASHRAE 15, ETL, cETL, NEC, and OSHA as adopted by the State.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Submittals shall include the following:
   1. Dimensioned plan and elevation view drawings, required clearances, and location of all field connections
   2. Summary of electrical requirements
   3. Schematic diagram of control system indicating points for field interface/connection
   4. Computer generated performance at scheduled conditions. Additionally, provide IEER, EER, and COP values certified to AHRI Std. 1230.
   5. Computer generated piping diagrams with all sizes indicated as well as an estimate of additional refrigerant requirements

D. Submittals shall include a list of all fan coil units by scheduled tag and corresponding address of each unit to allow for remote configuration of operational settings via a configurator software package.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For variable refrigerant air-conditioning units to include in emergency, operation, and maintenance manuals. Provide schedule of manufacturer's recommended service intervals of all serviceable components.

1.04 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.

B. Performance of equipment shall meet or exceed the scheduled values and be rated in accordance with Air Conditioning Refrigeration Institute's (ARI) Standard 210/240 and bear the ARI label.

C. All wiring shall be in accordance with the National Electric Code (NEC).

D. The system shall be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site and store and protect products under provisions of Division 01.

B. Protect units from physical damage until ready for installation.

1.06 COORDINATION

A. Coordinate sizes and locations of equipment support structures and concrete pads with actual equipment provided.

1.07 WARRANTY

A. All equipment shall include a 10 year limited parts and compressor warranty. Warranty will start on the date of unit commissioning or 90-days after delivery to jobsite, whichever occurs first.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the work include the following:
   1. Daikin
   2. L.G.
   3. Mitsulishi

2.02 GENERAL SYSTEM REQUIREMENTS

A. Voltage Platform – Heat Pump/Heat Recovery condensing units shall be available with 208-230V/1/60, 208-230V/3/60, or 460v/3/60 power supply as scheduled +/- 10%.

B. The published operating range in cooling or cooling dominate simultaneous cooling/heating shall be -4°F to 122°F (DB) or wider with an indoor temperature range of 57°F to 77°F (WB). The operating range in heating or heating dominate simultaneous cooling/heating shall be -13°F to 60°F (WB) or wider with an indoor temperature of 59°F to 80°F (DB).

C. A single system shall be capable of up to (64) temperature control zones on one piping network.

D. Each condensing unit shall be capable of being connected with indoor evaporator capacity of up to 200% of the condensing unit capacity.

E. Each condensing unit shall use all variable speed “inverter” compressor(s) coupled with inverter fan motors. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume to meet the needs of the cooling or heating loads. The control shall be automatic and customizable depending on load and weather conditions.

F. Each system shall include a refrigerant auto-charging function and a refrigerant charge checking function.

G. Systems shall maintain continuous heating during defrost operation and during oil return operation. Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle

H. On Heat Recovery Systems, the operating mode switch from heating to cooling or cooling to heating of any fan coil on the system shall not affect other fan coils on that system.

I. The following are piping minimum limitations – (Note: All values provided below are “one way”)
   1. Systems shall be capable of up to 540 ft (640 ft equivalent) of linear piping between the condensing unit and the furtherest indoor unit and up to 295 ft. downstream of the first branch.
   2. Systems shall be capable of up to 3,280 ft total piping in the piping network.

3. Systems shall be capable of a vertical (height) separation of up to 295 ft between the condensing unit and the lowest indoor unit and up to 98 ft elevation difference between indoor units.

J. Transmission (control) wiring shall utilize a “daisy-chain” configuration starting at the condensing unit. The home run from the outdoor unit to the first indoor unit shall not exceed 3280 ft. The entire wiring distance on any system shall not exceed 6560 ft.

K. Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.

L. Each system shall automatically restart operation after a power failure without loss of any settings.

M. Each system shall include a pressure relief valve to relieve pressure to the low pressure side of the system. Fusible plugs that vent to atmosphere will not be acceptable.

2.03 INDOOR UNITS

A. All Units
1. Factory assembled and tested including wiring, piping, electronic expansion valve, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. Unit shall be charged with dehydrated air prior to shipment from the factory.
3. PID control of the electronic expansion valve shall be used to control superheat
4. The indoor unit will be powered with 208-230V/1-phase/60Hz. (253 volts maximum and 187 volts minimum).
5. Coils shall be direct expansion type with copper tubes expanded into aluminum fins.
6. All units shall be equipped with return air, liquid, and gas line thermistors.
7. All fans shall be thermally protected.
8. All units shall be equipped with a programmed drying mode that dehumidifies while limiting changes in room temperature.
9. Each unit shall include a microprocessor-based control board to interface with remote controllers, centralized controllers, and EMCS if applicable.
10. Sound Power Levels shall not exceed scheduled or specified values when producing maximum airflow (high speed operation). If not specifically scheduled or specified, Sound Power Levels shall not exceed the values published for the scheduled models.
11. All units shall be available with a remote temperature sensor kit for when remote controller is not used or is not located within the space to be conditioned.

B. Hi Static Ducted Type (FXMQ-P)
1. Unit cabinet shall be constructed of galvanized steel with foam insulation.
2. Configuration shall be horizontal discharge / horizontal return.
3. Fan shall be a direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available. Unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning to accommodate high efficiency filters and/or distribution system losses.
4. Units shall include an integral condensate drain pump and condensate safety shutoff and alarm.
5. Installing contractor shall provide a filter rack designed to accept standard size filters and quantities to meet the minimum filter face area scheduled. Transition from unit RA connection as required. Alternatively, provide manufacturer’s optional filter rack accessory.
6. Units with a nominal capacity of 2.5-Tons or larger shall be equipped with and integral air-side economizer when indicated or scheduled.

C. Medium Static Ducted Type (FXSQ)
1. Unit cabinet shall be constructed of galvanized steel with foam insulation.
2. Configuration shall be horizontal discharge / horizontal return and shall be field convertible to a bottom return.

3. Fan shall be a direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available. Unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning to accommodate high efficiency filters and/or distribution system losses.
4. Units shall include an integral condensate drain pump and condensate safety shutoff and alarm.
5. Installing contractor shall provide a filter rack designed to accept standard size filters and quantities to meet the minimum filter face area scheduled. Transition from unit RA connection as required.

D. Hi Static Ducted Type (FXMQ-M)
1. Unit cabinet shall be constructed of galvanized steel with foam insulation.
2. Configuration shall be horizontal discharge / horizontal return.
3. Fan shall be a direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available. Unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning.
4. Units shall include a 1-5/16" outside diameter condensate drain connection for gravity drainage. Where indicated or required, include a remote condensate pump.
5. Installing contractor shall provide a filter rack designed to accept standard size filters and quantities to meet the minimum filter face area scheduled. Transition from unit RA connection as required. Alternatively, provide manufacturer's optional filter rack accessory.

2.04 OUTDOOR CONDENSING UNITS

A. Outdoor Condensing Units shall be weather proof fabricated from mild steel with a baked enamel corrosion resistant finish. Units shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit shall consist of inverter scroll compressors, motors, fans, condenser coil with sub-cooling circuit, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receivers and accumulators. The outdoor unit shall be modular in design and allow for side-by-side installation with minimum spacing be capable of being piped and wired from left, right, rear, or bottom.

B. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

C. Each condensing unit shall include at least one internally spring-isolated Neodymium magnet digitally commutating hermetically sealed variable speed "inverter" compressor coupled with inverter condensing fan motor. Inverter compressor capacity shall be modulated automatically to maintain a constant suction pressure while varying the refrigerant volume to meet the cooling and/or heating loads. The capacity control range shall be 4% to 100%.

D. In the event of a compressor failure the remaining compressor(s) shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be designed to specifically address this condition.

E. Units with multiple inverter compressors shall include a duty cycling function to equalize run hours and starts.

F. The sound pressure dB(A) for individual modules at rated conditions shall be not greater than 65 decibels at 3 feet from the front of the unit.

G. Unit shall include one vertical discharge propeller type, direct-drive fan with multiple speed operation via a DC inverter. The fan motor shall include permanently lubricated bearings and inherent motor protection. Fan shall be capable of up to 0.32" of external static pressure by a field adjustable setting. The fan assembly shall include a fan guard to prevent contact with moving parts. Night setback control of the fan motor for low noise operation shall automatically limit the maximum speed to one of (3) field selectable noise levels:

OPERATION SOUND dB(A)	NIGHT MODE SOUND PRESSURE LEVEL dB(A) APPROX.
Level 1	55
Level 2	50
Level 3	45

H. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM test standards.

I. Provide pre-manufactured insulated roof curb.
   1. Pre-fabricated roof curbs to be of prime galvanized steel construction, 14, 16, 18 or 20 gauge as required, meeting ASTM A653/653M, with welded corners and 3" cant fully mitered with seams joined by continuous welds. Curbs to be internally reinforced, factory insulated with 1 ½" thick 3 lbs. density fiberglass insulation, and factory installed wood nailers fastened from underside with Tek screws. Height to be 6" above roof deck. Top of all roof curbs shall be level, with pitch built into curb when deck slopes.

2.05 BRANCH SELECTOR BOXES FOR HEAT RECOVERY SYSTEMS

A. Provide factory-assembled and run tested Branch Selector Boxes (BSB) as indicated or scheduled. BSB's shall be available with up to 12 ports in increments of two capable of controlling up to 290 MBH of cooling capacity.

B. BSB's shall be fabricated with a galvanized steel casing insulated with sound absorbing flame and heat resistant foamed polyethylene resulting in a maximum sound pressure level of 40 dB(A) for any branch (circuit).

C. Each BSB branch shall include (3) electronic expansion valves and a subcooling heat exchanger. The use of solenoid valves for changeover and pressure equalization shall not be acceptable

D. BSB's shall not require condensate removal.

E. The unit electrical power shall be 208-230V/1 phase with an MCA of 0.1 and MOP of 15.

2.06 CONTROLS

A. General
   1. The complete control system, including local controllers and central controllers, shall be from the same company as the equipment providing single-source responsibility.
   2. All control wiring shall be daisy chain 18 AWG, 2 wire, multi-stranded, non-shielded and non-polarized.
   3. Installing contractor is responsible for wiring all equipment and controllers in accordance with the submitted wiring diagrams.

B. Local Controllers
   1. As indicated on the drawings, provide each unit with a wired local controller capable of interfacing with the fan coil control board to provide all operating functions in a stand-alone fashion including:
      a. Control/monitoring of unit
      b. Establishing a setpoint range to limit (or prohibit) temperature adjustment
      c. Setback/Setup temperature control during unoccupied periods
      d. Complete 7-day programmable scheduling
   2. Controller shall be backlit and have a built-in time clock with 48-hr backup.
   3. Controller shall include a temperature sensing thermistor and field adjustable settings to define whether the unit will be controlled based on their return air thermistor or the controller thermistor.

4. Controller shall be lockable thru a combination of buttons and include Field Settings to allow for prohibiting buttons on the Remote Controller such as “On/OFF”, “Mode”, and “Fan Speed” from being manipulated by unauthorized personnel.
5. Scheduling capabilities shall include:
   a. 7-Day, Weekday + Weekend, and Weekday + Saturday + Sunday patterns.
   b. Up to (5) On/Off actions per day
   c. Cool / Heat setpoints and unoccupied Setup / Setback setpoints
6. Remote sensor kit shall be provided as shown on the drawings from the manufacturer. The remote sensor shall not have any light emitting from it.

C. Central Controllers
1. Provide a central controller with graphical touch-screen interface to the fan coil control boards and/or local controllers as described above to provide all operating functions including:
   a. Control/monitoring of all units (indoor and outdoor)
   b. Establishing a setpoint range to limit (or prohibit) temperature adjustment at the local controller
   c. Setback/Setup temperature control during unoccupied periods.
   d. Complete 7-day programmable scheduling.
   e. Prohibit/Enable buttons on the local controllers.
2. Controller shall be capable of monitoring/control of up to (80) outdoor units, (512) local controllers, and (1024) actual indoor units.
3. Controller shall be capable of interfacing with input/output modules to control ancillary equipment including lights, exhaust fans, etc. via digital input modules.
4. Controller shall include a web interface to allow for monitoring/control of all aspects of the complete system via the internet with password protection.
5. Controller shall include icon, list, and floor plan views with the ability to control individual units directly from any view.
6. Controller shall be equipped with two RJ-45 Ethernet ports for 100 Mbps network communication to support interconnection with a network PC via the Internet, Local Area Network (LAN), or connection with a non-networked PC after completed installation.
7. Controller shall include RS485 terminals to allow monitoring and control of up to 960 contacts for 3rd party devices such as lighting controllers, exhaust fans, other air conditioning equipment, and security systems.
8. Controller shall include a USB port to allow for uploading and downloading of all system data. System shall include a preset tool such that the entire configuration can be completed off site and uploaded to the controller.
9. When supplied with an IP address, Controller shall:
   a. Provide password protected secure remote web access with full functionality.
   b. Send error emails to designated email addresses.
10. Controller shall be capable of functioning as a BACnet Client for monitoring/control of other BACnet compatible equipment using the BACnet/IP protocol. By registering equipment and sensors connected to a BACnet Client as management points, equipment and sensors can be monitored and controlled from the central controller. Supported BACnet point types include:
    a. Analog Input (Object Type Number 0)
    b. Analog Output (Object Type Number 1)
    c. Analog Value (Object Type Number 2)
    d. Binary Input (Object Type Number 3)
    e. Binary Output (Object Type Number 4)
    f. Binary Value (Object Type Number 5)
    g. Multi-Sate Input (Object Type Number 13)
    h. Multi-Sate Output (Object Type Number 14)
    i. Multi-Sate Value (Object Type Number 19)

11. Controller shall be capable of functioning as a BACnet Server Gateway device capable of exposing indoor unit management points as BACnet objects to the (BMS) using the BACnet/IP protocol. The BACnet Server shall allow the BMS to monitor and control the following BACnet objects:
    a. Indoor unit ON/OFF status.
    b. Alarm status with error description
    c. Room temperature.
    d. Indoor Unit ON details
        1) Off
        2) Normal [ON]
        3) Override
        4) Setback
    e. Filter sign status
    f. Fan status
    g. Communication status
    h. Thermo-on status
    i. Compressor status
        1) On
        2) Off
        3) Defrost
    j. Occupancy Mode
        1) Unoccupied
        2) Occupied
        3) Standby
    k. Operation Mode (Cool, Heat, Fan, and Dry)
    l. Cooling and Heating setpoints during occupied mode.
    m. Cooling and Heating setpoints during unoccupied mode.
    n. Maximum and minimum cooling setpoint.
    o. Maximum and minimum heating setpoint.
    p. Minimum cooling and heating setpoint differential.
    q. Fan Speed
        1) Up to 3 speeds (dependent upon indoor unit type)
    r. Vane direction (dependent upon indoor unit type)
        1) 5 fixed positions or swing position
    s. Remote controller permit/prohibit
        1) On/Off
        2) Mode
        3) Setpoint
    t. Filter sign reset for indoor units
    u. Forced indoor units off.

2.07 REFRIGERANT PIPING

A. Both liquid and suction lines shall be individually and completely insulated between the outdoor and indoor units with a minimum of ¾" insulation. Outdoor insulation shall be protected with a UV protective cover.

B. Drawings indicate general routing of refrigerant piping and may also show pipe sizes. If indicated, pipe sizes should be considered as representative only. Prior to beginning of work, installing contractor shall submit drawings showing the proposed locations of all equipment and routing of piping. The Equipment manufacturer shall size all refrigerant piping and provide an estimate of the additional refrigerant that will be required for each system.

2.08 CONDENSING UNIT EQUIPMENT SUPPORTS

A. Support condensing units and outdoor piping/conduit with an engineered system.
B. System shall be designed specifically for the selected equipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work.

B. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install units level and plumb.

C. Install refrigerant lines from Indoor Units to Condensing Units in accordance with manufacturer's recommendations.

D. Install condensate drain pipes from Indoor Unit drain pan to designated location shown on drawings. Provide minimum 1/8 inch per foot slope on all horizontal pipes.

E. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

F. Duct Connections: Duct installation requirements are specified in Division 23 Section "Ductwork". Drawings indicate the general arrangement of ducts. Connect supply ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

3.03 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. 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 motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.04 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.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

3.06 CONTROLS SERVICE CONTRACT

A. Include services to visit jobsite quarterly for the first year. Quarterly visits shall include (4) hours to review system operation and make adjustments which may be needed. Provide owner training as needed during visits.

END OF SECTION 23 8129

SECTION 23 8413

ULTRASONIC HUMIDIFIERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes Ultrasonic Humidifiers.

1.03 DEFINITIONS

A. 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.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, manifolds, and attachments to other work.
   1. Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals. Provide manufacturer recommended service intervals for all serviceable components.

1.06 COORDINATION

A. Coordinate location and installation of humidifiers with occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

PART 2 PRODUCTS

2.01 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.

B. Comply with AHRI 640.

2.02 ULTRASONIC HUMIDIFIERS

A. Manufacturer’s
   1. Stulz
   2. Other engineer approved manufacturer

B. The humidifier shall be of a self-contained ultrasonic type operating on the principle of ultrasonic nebulization. A signal from a humidistat, or a variable input sensing device, shall automatically monitor and control humidification.

C. The water supply shall be automatically controlled by a solenoid valve. The water level control in the unit shall be two float level controllers - one to sense high water level and one to sense low water level which serves as dry running protection. In the case of disruption of the water supply, overheating or detection of high mineral content levels, safety circuits shall shut off the humidifier. A heat sink dissipater shall be used to serve as temperature protection for the printed circuit control board and shall be located in the water tank of the nebulizing module.

D. Each nebulizing module shall be equipped with two oscillatory circuits. Each circuit shall use the "thickness vibration method" of humidification via a piezoelectric converter. The

piezoelectric converter shall generate electric high frequency energy in the oscillatory circuit and the electroacoustic power converter (ultrasonic transducer) shall convert the electric energy into mechanical energy, causing the water particles to vibrate at high speed (cavitation) to produce high energy vapor (nebula).

E. Stainless-steel piping is typically used with demineralized water.

F. The nebula particles shall have an average diameter of 1 micron (0.001 mm). Any water particles of larger diameter shall be trapped by the nebula blow-off cover and collected back in the water tank. The vibrating frequency of the ultrasonic humidifier shall range from 1.65 to 1.75 MHz

G. The ultrasonic humidifier shall have no water loss and have the capability to provide "instant on" and "instant off" operation for precise room humidity control.

H. Capacity Output shall be 100% at 48vdc supplied to the transducer. Frequency: 1.65 - 1.75 MHz. De-ionized water must be supplied to the ultrasonic humidifier in order to prevent any contaminants from being deposited into the room. The Resistivity of the de-ionized water shall be greater than 0.2 Meg-Ohms

I. Water Pressure Inlet Minimum and Maximum: 30 -75 psi

J. Control Box:
   1. This type of control box is equipped with a face-mounted ultrasonic proportional controller which is used to monitor, operate, and control the entire humidification system. The controller shall have an LCD display which continuously displays current conditions.
   2. The microprocessor is capable of recording the humidity upstream and, if necessary downstream of the humidifying process via sensors, and controls the output proportionally so that the saturation limit is not exceeded. The microprocessor is also capable of monitoring water conductivity and can be programmed to go through cleaning intervals by flushing the water tank for each humidifier via a stainless steel solenoid valve
   3. Upon receiving a call for humidification, the microprocessor shall switch ON the humidifiers for a time interval which is dependent on the strength of the control signal. The stronger the control signal, the longer the humidifiers will stay ON. Furthermore, the maximum output of the humidifier can be set at 100% or lower which further allows user to customize the humidification output to meet the application requirements.
   4. Each control box contains (up to qty 4) Electronic 48vdc Power Supplies, contactors, circuit breakers, switches and the microprocessor controller necessary to control the humidification system, and shall be housed in an enclosure designed for indoor use only. These control boxes shall be UL listed.
   5. Control Alarms, Displays and Signals

Alarms	**Displays**
Humidity too high	Operating condition
Humidity too low	Pre-alarm
Water Conductivity	Common alarm
Sensor cable fault	Supply valve activated
EE-prom fault	Drain valve activated
Transmission error	Unit output
Power supply	Current humidity
Common alarm	Set-point value - input 1
	Conductivity of water
	Set-point value - pre-alarm
Outputs	Set-point value - common alarm
	Remaining time - cleaning interval
Supply valve	Operating mode
Drain valve	Prop. Band - input 1
Common alarm	Maximum production
Humidify 1	Set-point value - humidity alarm "too high"
Humidify 2	Set-point value - humidity alarm "too low"

Set-point value - input 2
Prop. Band - input 2

Adjustable Inputs		
Set-point value - input 1 Prop. Band - input 1	**Input 1**	**Input 2** (Hi-limit)
Set-point value - limiting input 2	0-10 V	0-1 V
Prop. band limiting input 2	0-20 V	4-20 mA
	0-1 V	
Possible input signals from sensor or an external controller.	2-10 V 0-20 mA 4-20 mA	
Digital input for remote ON/OFF		

K. Accessories:
1. Humidistat: Wall-mounting, solid-state, electronic-sensor controller capable of full-modulation or cycling control.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install humidifiers with required clearance for service and maintenance.

B. Install all manufacturer-furnished accessories in accordance with manufacturer's written installation instructions.

3.03 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
1. Install piping adjacent to humidifiers to allow service and maintenance.

B. Install devices and piping specialties furnished by manufacturer but not factory mounted.

3.04 ELECTRICAL CONNECTIONS

A. Connect wiring according to Electrical specifications.

B. Ground equipment according to Electrical specifications.

3.05 CONTROLS CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between humidity sensors, high-limit humidity sensors, and DDC control system.

C. Connect control wiring between humidistats and controlled devices.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:
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 motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Humidifier will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain humidifiers.

END OF SECTION 23 8413

SECTION 26 0000

GENERAL ELECTRICAL SPECIFICATIONS

PART 1 GENERAL

1.01 WORK INCLUDED

A. This specification shall apply to all phases of Work hereinafter specified, shown on Drawings, or as required to provide a complete installation of electrical systems for this Project. Work required under this specification is not limited to just the Electrical Drawings - refer to Architectural, Structural, Landscape, and Mechanical/Plumbing Drawings, as well as all other drawings applicable to this project, which designate the scope of work to be accomplished. The intent of the Drawings and Specifications is to provide a complete and operable electrical system that includes all documents that are a part of the Contract.
   1. Work Included: Furnish labor, material, services and skilled supervision necessary for the construction, erection, installation, connections, testing, and adjustment of all circuits and electrical equipment specified herein, or shown or noted on Drawings, and its delivery to the Owner complete in all respects ready for use.
   2. The electrical Work includes installation or connection of certain materials and equipment furnished by others. Verify installation details, installation and rough-in locations from the actual equipment or from the equipment shop drawings.

B. Electrical Drawings: Electrical Drawings are diagrammatic, and are intended to convey the scope of work, indicating intended general arrangement of equipment, conduit and outlets. Follow Drawings in laying out Work and verify spaces for installation of materials and equipment based on actual dimensions of equipment furnished.

1.02 QUALITY ASSURANCE

A. Design, manufacture, testing and method of installation of all apparatus and materials furnished under requirements of these specifications shall conform to latest publications or standard rules of the following:
   1. Institute of Electrical and Electronic Engineers - IEEE
   2. National Electrical Manufacturers' Association - NEMA
   3. Underwriters' Laboratories, Inc. - UL
   4. National Fire Protection Association - NFPA
   5. Federal Specifications - Fed. Spec.
   6. American Society for Testing and Materials - ASTM
   7. American National Standards Institute - ANSI
   8. National Electrical Code - NEC
   9. National Electrical Safety Code - NESC
   10. Insulated Cable Engineers Association - ICEA
   11. American Institute of Steel Construction - AISC
   12. State and Municipal Codes In Force In The Specific Project Area
   13. Occupational Safety and Health Administration (OSHA)
   14. Electronics Industries Association/Telecommunications Industry Association (EIA/TIA)
   15. California Electrical Code (where adopted)
   16. Local Authority Having Jurisdiction (AHJ) Published Electrical Standards and Codes

B. Perform Work in accordance with the National Electrical Code, applicable building ordinances, and other applicable codes, hereinafter referred to as the "Code." The Contractor shall comply with the Code including local amendments and interpretations without added cost to the Owner. Where Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply unless variance is approved.
   1. Comply with all requirements for permits, licenses, fees and codes. The Contractor, at Contractor’s expense, shall obtain all permits, licenses, fees, special service costs,

inspections and arrangements required for Work under this contract, unless otherwise specified.

2. Comply with requirements of the applicable utility companies serving this Project. Make all arrangements with utility companies for proper coordination of Work.

1.03 GENERAL REQUIREMENTS

A. Guarantee: Furnish a written guarantee for a period of (1) one-year from date of acceptance.

B. Wherever a discrepancy in quantity or size of conduit, wire, equipment, devices, circuit breakers, etc., (all materials), arises on the Drawing and/or Specifications, the Contractor shall be responsible for providing and installing all material and services required by the strictest condition noted on Drawings and/or in Specifications to ensure complete and operable systems as required by the Owner and Engineer.

C. All Core Cutting, Drilling, and Patching:
   1. For the installation of work under this Section, the aforementioned shall be performed under this Section of the Specifications and the Concrete section of the Specifications.
   2. No holes will be allowed in any structural members without the written approval of the Project's Structural Engineer.
   3. For penetrations of concrete slabs or concrete footings, the work shall be as directed in the Concrete Section of Specifications.
   4. The Contractor shall be responsible for patching and repairing surfaces where he is required to penetrate for work under this contract.
   5. Penetrations shall be sealed to meet the rated integrity of the surface required to be patched and repaired. The patched surface shall be painted or finished to match the existing surface.

D. Verifying Drawings and Job Conditions:
   1. The Contractor shall examine all Drawings and Specifications in a manner to be fully cognizant of all work required under this Section.
   2. The Contractor shall visit the site and verify existing conditions. Where existing conditions differ from Drawings, adjustment(s) shall be made and allowances included for all necessary equipment to complete all parts of the Drawings and Specifications.

1.04 WORK IN COOPERATION WITH OTHER TRADES

A. Examine the Drawings and Specifications and determine the work to be performed by the electrical, mechanical and other trades. Provide the type and amount of electrical materials and equipment necessary to place this work in proper operation, completely wired, tested and ready for use. This shall include all conduit, wire, disconnects, relays, and other devices for the required operation sequence of all electrical, mechanical and other systems or equipment.

B. Provide a conduit-only system for low voltage wiring required for control of mechanical and plumbing equipment described in this or other parts of the Contract Documents. Install all control housings, conduits, and backboxes required for installing conductors to the controls.

C. Install separate conduits between each heating, ventilating and air conditioning sensing device and its control panel and/or control motor. Before installing any conduit for heating, ventilating and air conditioning control wiring, verify the exact requirements from the control diagrams provided with the equipment manufacturer's shop drawings.

1.05 TESTING AND ADJUSTMENT

A. Upon completion of all electrical work, the Contractor shall test all circuits, switches, light fixtures, lighting control and dimming systems including distributed systems, UPSs, generators, SPDs, lighting inverters, transfer switches, motors, circuit breakers, motor starters and their auxiliary circuits and any other electrical items to ensure perfect operation of all electrical equipment.

B. Equipment and parts in need of correction and discovered during such testing, shall be immediately repaired or replaced with all new equipment and that part of the system shall then be retested. All such replacement or repair shall be done at no additional cost to the Owner.

C. All circuit(s) shall be tested for continuity and circuit integrity. Adjustments shall be made for circuits not complying with testing criteria.

D. All test reports, including copies of any required Energy Code Acceptance Forms (e.g. CA Title 24 Acceptance for Code Compliance Forms) should be submitted to the Engineer at completion of project.

1.06 IDENTIFICATION

A. Nameplates shall be provided for unit substations, switchgear, switchboards, distribution boards, distribution panels, panel boards, motor control centers, transformers, transfer switches, contactors, starters, disconnect switches, enclosed circuit breakers/switches, inverters, UPSs, PDUs, RDCs, SPDs, lighting control panels, dimming panels, door releasing system panels, fire alarm/central monitoring terminal cabinets/power supplies/control panels, and all low voltage system terminal and control cabinets.

1. Nameplate inscriptions shall be identical to the equipment designations indicated in plans and specifications. Nameplates shall be engraved with the device designation/identification on the top line, source identification for the device on the 2nd line per NEC, or CEC where adopted, Art 408.4 and load designation for the device on the bottom line. Where load designation consists of a branch circuit, omit bottom line. Where device designation is not indicated on plans/specifications, Contractor shall submit a written clarification request to the Engineer.
   Example: Transformer 1TA
   Source Disconnecting Location: Switchboard MSA located in Rm 110
   Load: Panels 1LA and 1 LB
2. All circuit breakers/fuses in switchgear, switchboards, distribution boards, distribution panels, UPS output circuit breakers, PDU sub-feed circuit breakers and motor control centers shall have individual nameplates located immediately adjacent to the respective device. Nameplate inscription shall identify the downstream equipment or device served by the circuit breaker or fuse.

B. Identification nameplates, UON, shall be laminated/extruded modified acrylic that is 3/32" thick, UV-stabilized, matte finish, suitable for use in 180 deg. F ambient, with beveled edges and engraved white letters 3/8" high, minimum, on 1-1/2" high black background (utility/normal and optional standby power systems) for single line of text. Where two lines of text are required, provide minimum 2" high nameplate. Where three lines of text are required, provide minimum 2.5" high nameplate. Provide white letters on red background for all NEC, or CEC where adopted, Article 700 Emergency Systems, Article 701 Legally required standby systems and Article 708 COPS.

C. Identification nameplates for new switchgear, switchboards, distribution boards, distribution panels, panel boards and motor control centers shall be attached with switchgear manufacturer-provided screws via switchgear manufacturer factory pre-drilled holes. A factory option to rivet identification nameplates to the equipment is only acceptable if screw-fastened nameplates are not an available option from the switchgear manufacturer. Field drilling or other mechanical attachment methods that change/void the NEMA or NTRL rating of the enclosure are strictly forbidden.

D. Identification nameplates for transformers, transfer switches, disconnect switches, enclosed circuit breakers/switches, inverters, UPSs, PDUs, RDCs, SPDs, lighting control panels, dimming panels, door releasing system panels, terminal cabinets and all circuit breakers/fuses in switchgear, switchboards, distribution boards, distribution panels, UPS output circuit breakers, PDUs, PDU sub-feed circuit breakers, and motor control centers shall be attached to the equipment by self-adhesive backing integral to the nameplates. When equipment is located outdoors, provide nameplates without self-adhesive backing and attach to equipment using weather-rated, UV-resistant epoxy. In all cases, clean surfaces before applying identification nameplates parallel to equipment lines.

E. Warning Placards, as required by General Single Line Diagram Notes for multiple power sources, or instruction placards, as required for all kirk-key interlock schemes, all UPS bypass

procedures or as required elsewhere in the plans/specifications shall be engraved 1/2" high white lettering on a red background using the same material specified for identification nameplates with a self-adhesive backing. Warning/instruction placards shall be attached to the face of the equipment directly related to the placards. Provide a formal placard submittal for review by the Engineer prior to ordering any warning/instruction placards. In all cases, clean surfaces before applying warning/instruction placards parallel to equipment lines.

F. Receptacles that are part of a UL-listed under floor computer room whip assembly, ceiling and/or cable/ladder tray-mounted receptacles used in lab, manufacturing, commercial kitchen environments or that are serving telecom/data/AV racks and cabinets shall have identification nameplates located on the wiring device plate cover. Nameplates shall be self-adhesive, 3/32" thick Micarta with beveled edges, engraved 1/4" high white lettering on black background with serving power source, circuit identification and NEMA/IEC receptacle type. Use of two (2) separate nameplates per device plate cover is acceptable. Affix nameplates to be visible when plugs are occupying receptacles.

G. See wiring device section of this specification for wiring device plate cover labeling requirements.

H. See drawings for panel board schedule directory installation requirements.

I. See conduit installation section of this specification for conduit labeling requirements.

1.07 FINAL INSPECTION AND ACCEPTANCE

A. After all requirements of the Specifications and/or the Drawings have been fully completed; representatives of the Owner will inspect the work. Contractor shall provide competent personnel to demonstrate the operation of any item or system to the full satisfaction of each representative.

B. Final acceptance of the work will be made by the Owner after receipt of approval and recommendation of acceptance from each representative.

1.08 RECORD DRAWINGS

A. Drawings of Record: The Contractor shall provide and keep up-to-date, a complete record set of drawings. These shall be corrected daily and show every change from the original Drawings. This set of prints shall be kept on the job site and shall be used only as a record set. This shall not be construed as authorization for the Contractor to make changes in the layout without definite instruction in each case. Upon completion of the work, a set of reproducible Contract Drawings shall be obtained from the General Contractor and all changes as noted on the record set of prints shall be incorporated thereon with black ink in a neat, legible, understandable and professional manner. Refer to the Supplementary General Conditions for complete requirements.

1.09 APPROVALS, EQUALS, SUBSTITUTIONS, ALTERNATIVES, NO KNOW EQUAL

A. Approvals: Where the words (or similar terms) “approved”, “approval”, “acceptable”, and “acceptance” are used, it shall be understood that acceptance by the Owner, Architect and Engineer are required.

B. Equal: Where the words (or similar terms) “equal”, “approved equal”, “equal to”, “or equal by”, “or equal” and “equivalent” are used, it shall be understood that these words are followed by the expression “in the opinion of the Owner, Architect, and Engineer.” For the purposes of specifying products, the above words shall indicate the same size, made of the same construction materials, manufactured with equivalent life expectancy, having the same aesthetic appearance/style (includes craftsmanship, physical attributes, color and finish), and the same performance.

C. Substitution: For the purposes of specifying products, “substitution” shall refer to the submittal of a product not explicitly approved by the construction documents/ specifications.

1. Substitutions of specified equipment shall be submitted and received by the Engineer ten (10) days prior to the bid date for review and written approval. Regulatory Agency approval for all substitutions will be the sole responsibility of the Contractor. To receive consideration, requests for substitutions must be accompanied by documentary proof of its

equality with the specified material. Documentary proof shall be in letterform and identify the specified values/materials alongside proposed equal values/materials. In addition, catalog brochures and samples, if requested, must be included in the submittal. ONLY PRE-BID APPROVED PRODUCTS, ISSUED VIA A FORMAL BID ADDENDUM TO ALL BIDDERS, WILL BE ALLOWED ON THE PROJECT. REGARDLESS OF THE APPROVAL ON ANY SUBSTITUTION, ALL BIDS SHALL BE BASED ON THE PRODUCTS EXACTLY AS SPECIFIED. PRICING FOR EACH APPROVED SUBSTITUTION SHALL BE INCLUDED IN THE BID SUBMITTAL AS A SEPARATE LINE ITEM.

2. In the event that written authorization is given for a substitution, after award of contract, the Contractor shall submit to the Engineer quotations from suppliers/distributors of both the specified and proposed equal material for price comparison, as well as a verification of delivery dates that conform to the project schedule.
3. In the event of cost reduction, the Owner will be credited with 100 percent of the reduction, arranged by Change Order.
4. The Contractor warrants that substitutions proposed for specified items will fully perform the functions required.

D. Alternates/Alternatives: For the purposes of specifying products, “alternatives/alternates” may be established to enable the Owner/Architect/Engineer to compare costs where alternative materials or methods might be used. An alternate price shall be submitted in addition to the base bid for consideration. If the alternate is deemed acceptable, written authorization will be issued.

E. No Known Equal: For the purposes of specifying products, “No Known Equal” shall mean that the Owner/Architect/Engineer is not aware of an equivalent product. The Contractor will need to submit a “Substitution” item, per the requirements listed above, if a different product is proposed to be utilized.

1.10 SHOP DRAWINGS/SUBMITTALS

A. Shop Drawings/Submittals, unless required otherwise by general project specifications or instructions to bidders, shall be submitted in electronic format (PDF) to include a Letter of Transmittal (PDF), which shall give a list of the drawings submitted with dates and/or system(s) components contained within the submittal. Drawings and material cut sheets shall be complete in every respect and edited/marked to indicate specific items being provided. Printed/Hard copies are not acceptable.

B. The Shop Drawings/Submittals shall be marked with the name of the project, numbered consecutively, and bear the approval of the Contractor as evidence that the Contractor has checked the Drawings. Any Drawings submitted without this approval will be returned to the Contractor for resubmission.

C. If the shop drawings show variations from the requirements of the Contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in the Contractor’s letter of transmittal. If the substitution is accepted, the Contractor shall be responsible for proper adjustment that may be caused by the substitution. Samples shall be submitted when requested.

D. Only products listed as “Equal” within the contract documents, along with formally approved “Substitutions” will be reviewed. Products not conforming to these items will not be reviewed and will be returned to the Contractor for re-submittal.

E. Review comments used in response to shop drawings/submittals are:
1. “No Exception Taken” - Product approved as submitted.
2. “Furnish as Corrected” - Re-submittal not required, although the Contractor shall provide the submitted product with corrections as noted.
3. “Revise and Resubmit” - Re-submittal required with corrections as noted.
4. “Rejected” - Re-submittal required based upon the originally specified product.

F. Shop drawings shall be submitted on the following but not limited to:

1. Lighting Fixtures.
2. Switchgear, Switchboards, Distribution Boards, Motor Control Centers, Panel boards, and Bus Ducts; complete with overcurrent device information.
3. Transformers.
4. Fire Alarm System/Central Monitoring System.
5. Wiring Devices.
6. Lighting Control System/Dimming System Products.
7. Pullboxes and Underground Vaults.
8. Terminal Cabinets
9. Lighting Inverters, UPSs, RDCs, PDUs, Generators, Transfer Switches, SPD Systems.
10. Cable Tray, Flexible Cable Tray and Cable Runway.
11. Power Poles and Floor Boxes.
12. Arc Flash, Short-Circuit and Coordination studies.
13. All other products called out on drawings that call for shop drawing submittal.

1.11 MAINTENANCE, SERVICING, INSTRUCTION MANUALS AND WIRING DIAGRAMS

A. Prior to final acceptance of the job, the Electrical Contractor shall furnish to the Owner at least four (4) copies of operating, maintenance, and servicing instructions, as well as four (4) complete wiring diagrams for the following, but not limited to, items or equipment:
   1. Lighting Control System/Dimming Systems.
   2. Fire Alarm System.
   3. Transformers.
   4. Switchgear, Switchboards, Distribution Boards, Motor Control Centers, Panel boards, and Bus Ducts; complete with overcurrent device information
   5. Lighting Inverters, UPS's, PDUs, Generators, Transfer Switches, SPD Systems

B. All wiring diagrams shall specifically cover the system supplied. Typical drawings will not be accepted. Four (4) copies shall be presented to the Owner.

1.12 INTERRUPTION OF SERVICE/SERVICE SHUTDOWN

A. Any interruption of electrical services, electrical circuits, electrical feeders, signal systems, communication systems, fire alarm systems, etc. required to perform work, shall meet the specific prior-approval requirements of the Owner. Such work shall be scheduled with the Owner to be performed at the Owner's convenience.

B. Interruptions/outages of any of the Owner’s systems and services mentioned above shall be scheduled to occur during other than the Owner’s normal business hours. Any overtime costs shall be borne by the Contractor.

C. See drawings for any additional requirements regarding outages, interruption and any temporary services required.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials and Equipment: All electrical materials and equipment, including custom-made equipment, shall be new and shall be listed by Underwriter's Laboratories (UL) and bear their label or be listed and certified by a Nationally Recognized Testing Lab (NRTL) that is also recognized by the local Authority-Having-Jurisdiction (AHJ)

B. Switchgear/Switchboards/Distribution Boards/Motor Control Centers:
   1. See general single line notes on single line drawing for more information.

C. Panel boards – Branch Circuit:
   1. See drawings for panel board schedules and specifications.

D. Transformers:
   1. See drawings for transformer schedules and specifications.

E. Lighting Fixtures:

1. See drawings for lighting fixture and lamp schedules and additional specifications. Furnish, install and connect a lighting fixture at each outlet where a lighting fixture type symbol (designated on plans) is shown as being installed. Each fixture shall be complete with all required accessories including sockets, glassware, boxes, spacers, mounting devices, fire rating enclosure and lamps.
2. Ballasts: See lighting fixture schedule notes. All noisy ballasts shall be replaced at no cost to the Owner.
3. Lamps: See lamp/fixture schedule and lamp/lighting fixture schedule notes.

F. Wiring Devices:
1. Provide wiring devices indicated per plan. Devices shall be specification grade. Acceptable manufacturers are Leviton, Pass and Seymour and Hubbell. Provide all similar devices of same manufacturer, unless indicated otherwise. All device colors shall be from the full range of manufacturer standard color options as selected by the Architect. This selection will be made during the shop drawing review process
   a. Wiring Devices (Decora)

1)	Convenience Receptacle	#16252- ???
2)	Dedicated Receptacle	#16352-???
3)	Convenience I.G. Receptacle	#16262-IG-???
4)	Dedicated I.G. Receptacle	#16362-IG-???
5)	Convenience G.F.C.I. Receptacle	#GFT1-???
6)	Dedicated G.F.C.I. Receptacle	#GFNT2-???
7)	Tamper Resistant Convenience Receptacle	#TDR15-???
8)	Tamper Resistant Dedicated Receptacle	#TDR20-???
9)	Tamper Resistant GFCI Receptacle	#GFTR2-???
10)	Weather/Tamper Resistant GFCI Receptacle	#GFWT2-???
11)	Convenience Simplex Receptacle	#16251-???
12)	Dedicated Simplex Receptacle	#16351-???
13)	Recessed Clock Receptacle	#5361-CH-???(Non-Decora)
14)	Single Pole Switch	#5621-2-???
15)	Double Pole Switch	#5622-2-???
16)	Three Way Switch	#5623-2-???
17)	Four Way Switch	#5624-2-???
18)	Pilot Light Switch “On”	#5628-2-???
19)	Pilot Light Switch “Off”	#5631-2-???
20)	Projection Screen Switch	#5657-2-???
21)	Low Voltage Momentary Switch	#5657-2-???
22)	Keyed Switch	#1221-2L-???(Non-Decora)
23)	Door Jam Switch	#1865-???

   b. Use of dedicated receptacles is required where plans depict a branch circuit supplying only a single simplex or duplex receptacle. Use of controlled receptacles is required where depicted on plans - see controlled receptacle specifications for additional information.
2. I.G. (isolated ground) receptacle bodies shall be of a basic color specified above with an orange triangle to symbolize isolated ground.
3. When shown circuited with an I.G. conductor, receptacles shall be of an I.G. type. As an example, a NEMA L6-30R denoted on the plans and shown circuited with an I.G. conductor shall be an I.G. version of that receptacle.
4. Wiring devices located in wood finished areas shall generally be black unless otherwise indicated by the Architect.
5. Wiring devices located in mirrors shall generally be white with stainless steel cover plates unless otherwise indicated by the Architect.
6. In addition to other device requirements listed elsewhere in this specification, 125V (Volt), 15A (Amp) and 20A Tamper-Resistant wiring devices shall be provided as follows:
   a. In dwelling units per NEC, or CEC where adopted, Article 210.52.

b. In wet and/or exterior locations.

7. Wiring device cover plates located on recessed boxes shall be commercial grade nylon. Plate color shall match wiring device color UON on plans. Cover plates utilized on surface mounted boxes shall be metal. Plastic cover plates are unacceptable.
8. Except as otherwise noted, all wiring device plates on the project shall be labeled with panel and circuit number(s) utilizing a Brother P-Touch labeling system with 1/2" tape (yellow on black) or equal by Herman-Tellerman or Panduit. Locate label on the concealed side of the wiring device plate. Handwritten labels are unacceptable.
9. The following wiring device plates shall have custom engraving:
   a. Key operated switches, switches with pilot lights, and switches for the control of motors, heaters and ventilators. Engraving shall be black and occur on the exposed side of the plate indicating the motor, heater, or ventilator controlled.
   b. Receptacles on optional standby generator and/or UPS power shall have custom engraved plates with the words "Generator" or "UPS" in black letters. In addition, where located in telecommunications closets, IDFs, server rooms, data centers, labs (wet, dry or electronic) indicate panel board and circuit number.
   c. All stainless steel and nylon device plates shall be engraved using a rotary engraving process except for black lettering on stainless steel device plates which may be accomplished via laser etching process. All lettering shall be 3/16" high. Provide a dimensioned submittal drawing detailing a typical device faceplate with engraving.

G. Weatherproof Outlet Covers/Assemblies: All Receptacles identified as weatherproof on the drawings shall be weather-resistant, tamper-resistant, GFCI type and equipped as follows:
1. Type WP-A: Recessed wall box with a hinged, lockable, cast aluminum, self-closing, gasket-equipped door that is wet location-listed rain tight while "in use". Unit shall comply with NEC, or CEC where adopted, Article 406.9(A) and (B). UON on drawings, provide a minimum of 2 separate compartments suitable for installation of power receptacles, AV or communications outlets. Additionally, unless otherwise noted on drawings, provide the following:
   a. A 20A weather-resistant, tamper-resistant, GFCI duplex receptacle in the first compartment. Provide branch circuiting per plans.
   b. A blank metal plate suitable for field installation of power, AV or communications devices in the second compartment.
   c. Where indicated on plans as requiring data, AV, or other low voltage service outlet, provide minimum 3/4" C.O. with pull string routed from the second compartment to nearest low voltage pull box. Where shown mounted in a building wall, any blank/unused compartment shall be equipped min. 3/4" C.O. with pull string routed to the nearest accessible ceiling space.
   d. See wiring device section of this specification for additional wiring device plate cover labeling requirements.
   e. 1 key minimum per device (minimum of 2 per project) to the Owner's project manager upon completion of project.
   f. Custom color powder coat finish as selected by Architect - Include all costs in base bid for same.
   g. In locations with sufficient wall depth, provide 6" wide x 6" tall x 5-1/2" deep recessed wall box (C.W. Cole #TL310-WCS-K1-CUSTOM COLOR).
   h. In locations utilizing shallow stud walls construction or other walls of insufficient depth, provide 10-3/4" wide x 7-3/8" tall x 3-7/8" deep recessed wall box (C.W. Cole #TL310-WCS-SH-K1 -CUSTOM COLOR).
   i. See drawings for additional details.
2. Type/Subscript WP-B: Wet location-listed raintight while "in use" cast copper-free aluminum lockable cover with baked aluminum lacquer finish and one gang, weather-resistant, tamper-resistant GFCI receptacle. Hubbell WP26E series. Polycarbonate covers are unacceptable. Unit shall comply with NEC, or CEC where adopted, Article 406.9(A) and (B). Contractor shall powder coat cover assembly to a custom color where

receptacle locations are deemed by the Architect to be in aesthetically sensitive or public spaces. Custom color as selected by Architect.

3. Type WP-C: (C.W. Cole #TL310-WCS-PED-ADA-K1-CUSTOM COLOR or #TL310-WCS-PED-K1-CUSTOM COLOR) pedestal device box with a hinged, lockable, cast aluminum, self-closing, gasket-equipped door that is wet location-listed raintight while "in use". Unit shall comply with NEC, or CEC where adopted, Article 406.8(A) and (B). UON on drawings, provide a minimum of 2 separate compartments suitable for installation power receptacles, AV or communications outlets. Additionally, unless otherwise noted on drawings, provide the following:
   a. A 20A weather-resistant, tamper-resistant, GFCI duplex receptacle in the first compartment. Provide branch circuiting per plans.
   b. A blank metal plate suitable for field installation of power, AV or communications devices in the second compartment.
   c. Where indicated on plans as requiring data, AV, or other low voltage service outlet, provide minimum 3/4" C.O. with pull string routed from the second compartment to nearest low voltage pull box.
   d. See wiring device section of this specification for additional wiring device plate cover labeling requirements.
   e. 1 key minimum per device (minimum of 2 per project) to the Owner's project manager upon completion of project.
   f. Include all costs in base bid for ADA version (22.5" tall) of pedestal box. Prior to ordering material, contractor shall coordinate with Architect and/or AHJ to determine which pedestal box locations do not require ADA compliance and may be changed to the standard (11.5" tall) version of the pedestal box.
   g. Custom color powder coat finish as selected by Architect. Include all costs in base bid for same.
   h. See drawings for additional details.
4. Type/Subscript WP-D: Damp location-listed (not-Raintite-in-use) cast copper-free, pad lockable, die-cast aluminum cover with baked aluminum lacquer finish and one gang GFCI receptacle. Hubbell/Rayco 502?/503? Series. Polycarbonate covers are unacceptable. Unit shall comply with NEC, or CEC where adopted, article 406.9(A) and (B). Custom color powder coat finish as selected by Architect. Include all costs in base bid for same.

H. Motor Controllers/Starters: See drawings for motorized equipment schedules and specifications.

I. Circuit Breakers:
1. All non-service entrance circuit breakers 225A and larger shall be thermal magnetic type and have continuously adjustable instantaneous pick-ups of approximately 5 to 10 times trip rating. Breakers shall have either tamper-resistant rating dials or easily changed trip rating plugs with trip ratings as indicated on the Drawings. Rating plugs shall be interlocked so they are not interchangeable between frames. Additionally, all non-service entrance circuit breakers, 600A frame and larger, located in 480V, 3-phase, 3-wire or 277/480V, 3-phase, 4-wire switchgear, distribution boards, panel boards or busway plugs shall be solid state, 100% rated. Breaker shall have built-in test points for testing long delay, short delay and instantaneous, and ground fault (where shown) functions of the breaker by means of a 120V operated test kit. Contractor shall utilize a test kit capable of testing all breakers 400A and above - at the Engineer’s request.
2. All non-service entrance circuit breakers less than 225A shall be molded plastic case, air circuit breakers conforming to UL 489. Provide breakers with thermal magnetic trip units, and a common trip bar for two- or three-pole breakers, connected internally to each pole so tripping of one pole will automatically trip all poles of each breaker. Provide breakers of trip-free and trip-indicating bolt-on type, with quick-make, quick-break contacts. Provide single two- or three-pole breaker interchangeability. Provide padlocking device for circuit breakers as shown on the Drawings.
3. Where a Current Limiting Circuit Breaker (CLCB) is indicated on drawings or as required elsewhere in this specification, provide a UL listed current limiting thermal magnetic circuit

breaker(s) UON. An independently operating limiter section within a molded case is not allowed. Coordinate CLCB ratings as required to protect electrical system components on the load side of the CLCB to include, but not limited to, protecting automatic transfer switches, panel boards and lighting control panels.

4. Where a solid-state circuit breaker is indicated on drawings or as required elsewhere in this specification, provide a solid-state circuit breaker with minimum five function complete with built-in current transformers. The five functions shall be independently adjustable and consist of Overload/Long Time Amp Rating, Long Time Delay, Short Time Delay, Short Circuit/Instantaneous Pickup, but may also include Shunt Trip and/or Ground Fault if so indicated on the Drawings. Rating plugs shall be interlocked so they are not interchangeable between frames. Breaker shall have built-in test points for testing long delay and instantaneous, and ground fault (where shown) functions of the breaker by means of a 120V operated test kit. Contractor shall utilize a test kit capable of testing all breakers 400A and above, at the Engineer's request.
5. Ground Fault Interrupting Breakers: Provide with molded plastic case, air circuit breakers, similar to above with ground fault circuit interrupt capability, conforming to UL Class A, Group 1.
6. Arc Fault Interrupting Breakers: Provide with molded plastic case, air circuit breakers, similar to above with arc fault circuit interrupt capability, conforming to UL 1699. Provide on all dwelling-unit circuits supplying bedrooms, sleeping quarters etc. as required to comply with NEC, or CEC where adopted, Article 210.12.
7. Tandem or half-sized circuit breakers are not permitted.
8. Series-Rated Breakers: UL listed series-rated combinations of breakers can be used to obtain panelboard-interrupting ratings shown on Drawings. If series-rated breakers are used, switchboards, distribution boards, and panel boards shall be appropriately labeled to indicate the use of series-rated breakers. Shop drawing submittal shall include chart of UL listed devices, which coordinate to provide series rating.
9. Circuit breakers shall be standard interrupting construction. Panelboard shall accept standard circuit breakers up to 100A.
10. Circuit breaker handle accessories shall provide provisions for locking handle in the on or off position.
11. Shunt-trip equipped circuit breakers shall be provided on all elevator feeders.
12. Temperature compensating circuit breaker(s) shall be provided when located in outdoor enclosure(s) or when located in an enclosure subject to high ambient heat due to due nearby industrial processes, etc.
13. Provide 75 degree Celsius-rated conductor lugs/lug kits as required on all circuit breakers to accept conductor quantities and sizes shown on drawings.
14. All circuit breaker terminations shall be suitable for use with 75-degree Celsius ampacity conductors. Listed, dual-rated pin terminals, straight or offset, are acceptable for use to in accommodating oversized or parallel conductor installations.
15. Circuit breakers serving Fire Alarm or Central Monitoring panels and power supplies shall be red in color and lockable in the "ON" position.

J. Disconnect Switches:
   1. Non-fusible or fusible, heavy-duty, externally-operated horsepower-rated, 600V A.C: Provide NEMA 3R, lockable enclosures for all switches located on rooftops, in wet or damp areas and in any area exposed to the elements.
   2. Fusible switches shall be Class "R" when 600A or less or Class "L" when greater than 600A.
   3. Amperage, Horsepower, Voltage and number of poles per drawings: All shall be clearly marked on the switch nameplate.
   4. Provide the Owner's project manager with one (1) spare set of fuses and two (2) sets of fuse clips/fuses for every set of fuses on the project.

K. Fuses:

1. Provide fuses at all locations shown on the Drawings and as required for supplemental protection:
    a. Fuses shall be manufactured by Bussman, Shawmut, or equal.
    b. All fuses shall be the product of a single manufacturer.
2. Main and Feeder Protection:
    a. Protective devices rated greater than 600A: Provide Bussman Hi-Cap fuses, Class L, current limiting, having an interrupting rating of 200,000A RMS.
    b. Protective devices rated 600A or less: Provide Bussman Class R fuses, Class RK series current limiting fuses, having an interrupting rating of 200,000A RMS.
3. Motor Protection:
    a. Where rating of protective device is greater than 600A, provide Bussman Hi-Cap fuses, Class L, current limiting, having an interrupting rating of 200,000A RMS.
    b. Where rating of protective device is 600A or less, provide Bussman Class RK series current limiting fuses, having an interrupting rating of 200,000A RMS.
    c. Where fuses feeding motors are indicated, but not sized, it shall be the responsibility of the Contractor to coordinate the fuse size with the motor to provide proper motor running protection.
    d. When rejection type fuses are specified (Class RK series) the fuse holder of all switches (specified in other Sections) shall be suitable for the fuses provided.

L. Cable Tray, Flexible Cable Tray and/or Cable Runway:
1. See drawings for Cable Tray, Flexible Cable Tray and/or Cable Runway specifications.

M. Uninterruptible Power Systems (UPS):
1. See drawings for UPS schedules and specifications.

N. Power Distribution Units (PDU):
1. See drawings for PDU schedules and specifications.

O. Lighting Control/Dimming Systems:
1. See drawings for Lighting Control and/or Dimming Systems schedules and specifications.
2. Wall box dimmers shall be rocker-type as manufactured by Lutron (no known equal except as noted below). Dimmers and dimmer faceplates shall match the color of adjacent switches and faceplates. Dimmers and dimmer faceplates in wood finished areas shall generally be black unless otherwise indicated by the Architect. The Contractor shall obtain written approval of the Architect regarding final dimmer and dimmer faceplate color selection prior to ordering material. Multiple dimmers/switches shall be ganged together with a common cover plate. Provide dimmers as follows:
    a. Incandescent: Lutron DIVA DV-10P or DV-103P (3-way) (1000-Watt max.).
    b. Electronic Low Voltage: Lutron DIVA DVELV-300P or DVELV-303P- (3-way) (300 Watt).
    c. Magnetic Low Voltage: Lutron DIVA DVLV-10P or DVLV103p (3-way) (800-Watt max.).
    d. Fluorescent (3-Wire): Lutron DIVA DVF-103P (single/3way, 8A @ 120V) or DVF-103P-277 (single/3way, 6A @ 277V).
    e. Fluorescent (0-10V): Lutron DIVA DVTV with PP-???H Power Pack.
    f. Fluorescent (Lutron Tu-Wire): Lutron DIVA DVFTU-5A3P with Lutron H.P. module where required.
    g. LED (0 - 10V): Lutron DIVA DVTV with PP-???H Power Pack.
    h. Screw Base CFL/LED: Lutron DIVA DVCL-153P.
    i. Fan Control: Lutron DIVA DVFSQ-F (1.5A @ 120V max, 3 speed, single pole, 3-way).
3. Contractor shall verify if dimmer(s) requires derating when ganged. Contractor shall provide, and provide connections to, additional Lutron Power Modules, Lutron Power Packs, and / or Lutron Interface Modules where required to accommodate loads higher than dimmers standard or derated load-carrying capacity. Note - contractor may to

provide a Lutron recommended dimmer type (typically a #DVF-103P unit) to control the necessary power modules or interface devices.

P. Fire Alarm System/Central Monitoring System:
   1. See drawings for Fire Alarm System or Central Monitoring System specifications.

Q. Surge Protective Device (SPD):
   1. See drawings for SPD specifications.

R. Conduit:
   1. Galvanized Rigid Conduit (GRC) shall be full weight threaded type steel. Steel conduit shall be protected by overall zinc coating to inside and outside surfaces, applied by the hot dip, metalizing, or sherardizing process.
   2. Intermediate Metal Conduit (IMC), shall be hot-dipped galvanized in accordance with UL 1242, and meet Federal Specification WWC-581 (latest revision).
   3. Electrical Metallic Tubing (EMT) shall be zinc-coated steel with baked enamel or plastic finish on inside surfaces. EMT shall be dipped in a chromic acid bath to chemically form a corrosion-resistant protective coating of zinc chromate over galvanized surface.
   4. Flexible metal conduit shall be constructed of aluminum or hot-dipped galvanized steel strips wound spirally with interlocking edges to provide greatest flexibility with maximum strength. Interior surfaces shall be smooth and offer minimum drag to pulling in conductors. Use only as directed in writing by the Engineer with the exception of 400 Hz feeders and 400 Hz branch circuits which shall be run in flexible aluminum conduit.
   5. Liquid-tight conduit (Seal-Tite) shall be galvanized steel flexible conduit as above except with moisture and oil-proof jacket, pre-cut lengths and factory-installed fittings. For outdoor installations and motor connections only unless otherwise noted on drawings.
   6. Factory assembled, or off-site assembled wiring systems (such as Metal Clad (MC) Cable, Type AC Cable, Type NM Cable, Type BX Cable, etc.) shall not be used unless otherwise indicated in the Allowed Specification Deviations Section or Deductive/Additive Alternate Pricing Section generally located on the symbols list drawing.
   7. When approved for use in the Allowed Specification Deviations Section, generally located on the symbols list drawing, MC cables shall be allowed for lighting branch circuits (homeruns shall be EMT), receptacle branch circuits (homeruns shall be EMT) and poke-thru fed systems furniture homeruns. MC shall not be used where exposed, except for a maximum 6' length for final connections to light fixtures, or terminate in electrical panelboards or distribution boards. Equipment ground conductor shall be green. Isolated ground conductor shall be green with yellow stripe. Provide 600V rated aluminum or lightweight steel interlocking armor Metal Clad (MC) cable with copper conductors, THHN (90-degree C) insulation, and integral equipment grounding conductor and isolated grounding conductor as required. Type AC and MC cable shall not be used for essential electrical system branch circuits. MC cable shall be manufactured to Underwriter Laboratory Standard 1569. See PART 3 - EXECUTION section of this specification for additional installation requirements.
   8. Nonmetallic Flexible Tubing (ENT) shall not be used unless otherwise indicated in the Allowed Specification Deviations Section or Deductive/Additive Alternate Pricing Section generally located on the symbols list drawing. Use of ENT, if allowed, is strictly limited to use in CMU walls and parking structures decks or as directed in writing by the Engineer. See PART 3 - EXECUTION section in this specification for additional installation requirements.
   9. Non-Metallic Conduit:
      a. Polyvinyl chloride (PVC) rigid conduit, Schedule 40, Type II for underground installation only with solvent welded joints, conforming to Underwriters Laboratories, Inc. (UL) requirements, listed for exposed and direct burial application.
      b. Conduit and fittings shall be produced by the same manufacturer.
   10. Fire-rated MC Cable:
      a. 2-hour fire-rated, polymer insulated 600V MC cable listed and conforming to Underwriters Laboratories, Inc. (UL) 2196 and UL 1569 requirements for installation

as an Electrical Circuit Protective System for use in complying with NEC, or CEC where adopted, Articles 695 and 700. Where adopted, cable sheath shall be suitable for use as a NEC or CEC equipment grounding conductor, and shall be listed for use in wet locations to 90 degrees C (Raychem or equal).

b. Cable connectors shall be brass MC connectors.

S. Fittings:

1. Condulet type fittings shall be smooth inside and out, taper threaded with integral insulating bushing and of the shapes, sizes and types required to facilitate installation or removal of wires and cables from the conduit and tubing system. These fittings shall be of metal, smooth inside and out, thoroughly galvanized, and sherardized cadmium plated.
2. Metallic condulet covers shall have the same finish as the fitting and shall be provided for the opening of each fitting where conductors do not pass through the cover.
3. Connector, coupling, locknut, bushings and caps used with rigid conduit shall be steel, threaded and thoroughly galvanized. Bushings shall be insulated.
4. UON all EMT fittings, connectors and couplings installed in concealed locations, areas not considered to be wet or damp locations by the AHJ, or areas not subject to physical damage, shall be steel, zinc or cadmium plated, threadless, compression, steel locking ring type with insulated throat. Where suitable for use, steel set screw fittings are allowed for trades sizes of 2” and smaller. Insulated throat is not required for fittings, connectors and couplings 1” and smaller.
5. All interior and exterior EMT fittings, connectors and couplings, 2” and smaller, installed in exposed or concealed locations that are considered by the AHJ to be wet or damp locations, shall be Raintite-listed, steel, zinc or cadmium plated, threadless, compression, steel locking ring type with insulated throat. If Raintite-listed, EMT fittings, connectors and couplings are unavailable for a given trade size or if conduit is installed in an area subject to damage – provide rigid metallic or intermediate metallic conduits, fittings, connectors and couplings as required.
6. Flexible steel conduit connectors shall be a malleable iron clamp or squeeze type or steel twist-in type with insulated throat. The finish shall be zinc or cadmium plating.
7. Conduit unions shall be "Erickson" couplings, or approved equal. The use of running threads will not be permitted.

T. 600 Volt Conductors - Wire and Cable:

1. All conductors shall be copper. Provide stranded conductor for #10 AWG and larger or when making flexible connections to vibrating machinery. Use compression "fork" type connectors or transition to solid conductors when connecting to switches, receptacles, etc.
2. Type THHN/THWN-2 thermoplastic, 600 volt, UL approved, dry and wet locations rated at 90 degrees Celsius, for conductors of all sizes from #12 AWG up to and including 1000 kcmil. RHH/RHW insulation is allowed only to provide an Electrical Circuit Protective System to comply with NEC, or CEC where adopted, Articles 695 and 700.
3. Wire and cable shall be new, manufactured not more than six (6) months prior to installation, shall have size, type of insulation, voltage rating and manufacturer's name permanently marked on outer covering at regular intervals.
4. Wire and cable shall be factory color-coded by integral pigmentation with a separate color for each phase and neutral. Each system shall be color-coded and it shall be maintained throughout.
5. Systems Conductor Color Coding:
   a. Power 208/120V, 3PH, 4W:
      1) Phase A = Black
      2) Phase B = Red
      3) Phase C = Blue
      4) Neutral = White or White with Phase Color Tracer
      5) Switch legs = Purple (Switch legs shall also be identified separately by numerical tags).
      6) Travelers = Purple with Black stripe or Pink.

b. Power 480/277V, 3PH, 4W:
    1) Phase A = Orange
    2) Phase C = Yellow
    3) Neutral = Grey or Grey with Phase Color Tracer
    4) Switch legs = Purple (Switch legs shall also be identified separately by numerical tags).
    5) Travelers = Purple with black stripe or Pink..
c. Ground Conductors: Green
d. Isolated Ground Conductors: Green with continuous yellow stripe.
e. Fire Alarm System: As recommended by the manufacturer.

6. All color-coding for #12 through #6 AWG conductor shall be as identified above. Conductors #4 AWG and larger shall be identified with utilizing phase tape at each termination.
7. No conductors carrying 120V or more shall be smaller than #12 AWG.
8. Aluminum conductors shall not be used.
9. Wire-pulling compounds used as lubricants in installing conductors in raceways shall only be "Polywater J". No oil, grease, graphite, or similar substances may be used. Pulling of #1/0 or larger conductors shall be done with an approved cable pull machine. Other methods; e.g. using vehicles and block and tackle to install conductors are not acceptable.

U. Junction and Pullboxes:
1. For interior dry locations, boxes shall be NEMA 1 galvanized one-piece drawn steel, knockout type, with removable, machine screw secured covers.
2. For outside, damp or surface locations, boxes shall be NEMA 3R heavy cast aluminum or cast iron with removable, gasketed, non-ferrous machine screw secured covers.
3. For in-grade applications, junction and pull boxes shall be pre-cast concrete or molded fiberglass manufactured by Christy, Brooks-Jensen, or Utility Vault Co. Fiberglass boxes shall:
    a. Be used only in landscape planter areas that are not subject to damage from lawnmowers, tractors and other machinery.
    b. Not be used in lawn or turf areas.
    c. Not exceed 11” W x 17” L in size unless required to be larger to meet code requirements.
4. All boxes shall be sized for the number and sizes of conductors and conduits entering the box and equipped with plaster rings where required.
5. All boxes located in traffic areas shall be traffic rated.

V. Outlet Boxes:
1. For fixtures, boxes shall be galvanized, one-piece drawn steel, knockout type equipped with 3/8" fixture studs and plaster rings where required.
2. For convenience outlets, wall switches, or other devices, outlet boxes shall be galvanized one-piece drawn steel, knockout type 4" x 4"x 2-1/8" minimum size with plaster rings as required.
3. For locations where standard boxes are not suitable due to number and size of conduit to be terminated, special boxes shall be designed to fit space or meet other requirements, and submitted for approval.
4. For exposure to weather, damp locations, or surface mounting, outlet boxes shall be heavy cast aluminum or cast iron with threaded hubs; covers shall be watertight with gaskets and non-ferrous screws.
5. Outlet boxes used for support of ceiling fans shall be galvanized, one-piece drawn steel, knockout type equipped with bracing bars and plaster rings where required and listed for ceiling fan support use. Such boxes shall be labeled and capable of supporting ceiling fan weights up to 70 pounds.
6. See drawings for floor box installation notes and specifications.

W. Plywood Backboards: Where indicated for telephone or communications system terminals or other equipment assemblies, provide backboards of size indicated. Use 3/4" thick x 8' all

(length per plans), Douglas Fir, void-free, kiln-dried, fire-rated plywood finished on one side and prime coat painted on all surfaces with finish coat of enamel paint, color by Architect. Leave one (1) fire-rating stamp/sheet exposed for inspection.

X. Terminal Cabinets:
   1. Terminal cabinets shall be fabricated of hot dipped galvanized code gauge sheet metal for flush or surface mounting, complete with barriered sections, a door for each vertically barriered section and sizes as indicated on plan. Doors shall be hinged and lockable. Locks shall be keyed to match the branch circuit panelboards. Terminal cabinet trims shall match the branch circuit panels.
   2. Provide each terminal cabinet with a full size mounting backplate.
   3. Terminal cabinets shall be installed complete with full-length skirts of the same construction and finish as the terminal cabinet.
   4. Where mounted outdoors, terminal cabinets shall be NEMA 3R, weatherproof complete with gaskets and required sealant to prevent moisture from entering the terminal cabinet.
   5. All terminal cabinets and terminal cabinet barriered sections shall be labeled by the cabinet or cabinet section use (i.e. CATV, Security, etc.). Labels shall be Micarta type as specified elsewhere in these specifications. Unless otherwise noted, all termination blocks and cables shall be labeled per ANSI/EIA 606 standard.

Y. Painting: Terminal cabinets, panels, junction boxes, pull boxes, etc., and conduit installed in public view shall be painted with colors selected by the Architect to match the subject surfaces. Refer to painting section of the specifications for additional requirements.

Z. Seismic Design, Certification and Anchoring of Electrical Equipment:
   1. Contractor shall include all costs in the base bid for labor, materials, all special inspections and structural engineering design necessary to meet the Seismic Design Requirements for Non-structural Components (Chapter 13, ACE SEI 7-05 Minimum Design loads for Buildings and Other Structures) as required by IBC, or CBC where adopted, Section 1708 and as related to the installation all electrical equipment furnished under this contract. See Specific Project Site Seismic Criteria on architectural and/or structural plans which include Building Occupancy Category, Seismic Design Category, Design Spectral Response Acceleration (S_{DS}), Height factor ratio (z/h) and Site Class. Non-structural Component Importance Factor (I_P) for a particular component shall be determined based on the following criteria:
      a. I_P = 1.0: Non-life safety, Non-structural Components in an Occupancy Category IV Facility not required for continued operations of the facility or in any other Occupancy Category Facility where component failure will not impair continued operation of the facility.
      b. I_P=1.5: Designated Seismic Systems are those non-structural components in any Occupancy Category IV facility (except as noted above) or that are a part of any code-defined Critical, Life Safety, Emergency and Legally Required Standby Electrical System. Additionally, those non-structural components containing hazardous materials shall be classified as Designated Seismic Systems. While Designated Seismic Systems are generally identified on the plans, they may include items such as generators, automatic transfer switches, UPS units and all associated electrical distribution equipment and components necessary for the designated seismic system to form a complete and operable system. The Contractor shall ultimately be responsible for identifying Designated Seismic Systems. For any electrical component either identified on the plans or determined by the contractor to be a Designated Seismic System, all line and load side electrical distribution systems supporting that Designated Seismic System (including, but not limited to, feeders, panel boards switchboards, transformers, all related component supports and attachments etc.) shall be considered a part of the designated seismic system for the purposes of code-compliance and seismic certification.
      c. z/h - Height factor ratio: See plans for respective equipment locations.

2. Provide a delegated-design submittal for each of the following seismic-restraint systems to be used as required:
    a. Restraint Channel Bracings consisting of MFMA-4, shop-or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.
    b. Restraint Cables consisting of ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service, with a minimum of two clamping bolts for cable engagement.
    c. Seismic-Restraint Accessories consisting of hanger rod/hanger rod stiffener assemblies, multifunctional steel connectors for attaching hangers to rigid channel bracings and/or restraint cables, bushings for floor and wall-mounted equipment anchor bolts and resilient isolation washers and bushings.
    d. Mechanical Anchor Bolts consisting of drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
    e. Adhesive Anchor Bolts consisting of drilled-in and capsule anchor system containing resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide specific LEED-compatible environmentally-friendly resins and adhesives on all LEED projects. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
3. Submittal shall include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the contractor's structural engineer responsible for their preparation. Calculations shall include, but not be limited to, static and dynamic loading caused by equipment weight, operation, and seismic and, if applicable, wind forces required to select seismic and, if applicable, wind restraints and for designing vibration isolation bases. Provide seismic and wind-restraint detailing to support system selection, arrangement of restraints, attachment locations, methods, and spacings with all components identified to include their strengths, directions and values of forces transmitted to the structure during seismic events and association with vibration isolation devices. Sizes of components shall be selected so strength will be adequate to carry present static and seismic loads to accommodate 25% spare future capacity within specified loading limits.
4. Any pre-approval and evaluation documentation shall have a California Office of Statewide Health Planning and Development (OSHPD) Special Seismic Certification Preapproval (OSP) demonstrating horizontal and vertical load testing and analysis showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. 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) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
5. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified elsewhere in the project specifications.
6. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment. Flexible connection limitations of the NEC, or CEC where adopted, shall apply.

7. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
8. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
9. The contractor shall engage a qualified testing agency to perform tests and inspections as listed in other Project Specifications, but as a minimum shall include at least four of each type and size of installed anchors and fasteners selected by Architect. Schedule tests with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members as required. Test to 90 percent of rated proof load of device. Prepare and submit test and inspections reports.

AA. Trenching and Backfilling: Contractor shall be responsible for trenching and backfilling. Refer to Trenching and Backfilling section of the specifications for complete requirements.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

A. Installation of Conduit and Outlet Boxes:
1. All conduit installed in the dry walls or ceilings of a building shall be steel tube (EMT), aluminum tube (EMT), or Intermediate Metal Conduit (IMC). Flexible conduit shall not be used in lieu of EMT, IMC or rigid conduit except as noted herein.
2. Galvanized rigid conduit (GRC) or intermediate metal conduit (IMC) shall be used as follows:
   a. When noted on the drawings.
   b. When considered exposed to damage by the local AHJ.
   c. When installed in wet or damp locations and of a trade size where listed-Raintite fittings, connectors, couplings etc. are unavailable.
   d. When required by NEC or CEC Article 517.13.
   e. When installed in concrete and masonry. The use of ENT in CMU walls and parking structures may be allowed only as directed in writing by the Engineer. Request for ENT substitution must be made prior to bid and in accordance with pre-bid substitution requests requirements of these specifications.
3. Intermediate metal conduit (IMC), is approved for use in all locations as approved for GRC or steel-tube EMT and in accordance with NEC, or CEC where adopted, Article 342.
4. Flexible steel conduit shall only be permitted to be used at light fixture outlets and connections to vibrating electrical equipment. Except when concealed in walls or other structural elements, all flexible steel conduit runs shall be less than 6'-0". All outdoor installation shall be made using liquid-tight flex with approved fittings. Include a separate insulated green ground conductor sized per NEC in each conduit. Other uses of flexible conduit shall be allowed only as approved in writing by the Engineer.
5. Flexible liquidtight conduit shall be installed in lieu of the flexible steel; where required by the NEC, or CEC where adopted, in damp and wet location, where exposed to weather, in refrigerated area (65°F or less), and/or between seismic joints. All rotating electrical equipment shall be supplied with flexible, liquid-tight conduit with appropriate slack and shall not exceed thirty-six (36) inches. Include a separate insulated green ground conductor sized per NEC in each conduit. Other uses of liquidtight flexible conduit shall be allowed as approved in writing by the Engineer on a case by case basis.
6. Rigid metallic conduit installed underground or embedded in concrete shall be 1” trade size minimum and shall be wrapped with 20 mil. Polyvinylchloride plastic tape, PVC conduit installed underground or embedded in concrete shall be 3/4" minimum trade size.
7. Where required for providing an electrical circuit protective system to comply with NEC, or CEC where adopted, Articles 695 and 700 utilize UL Listed 2-hour fire-rated, MC cable or UL Listed 2-hour fire-rated RHH/RHW conductors in conduit.
8. Conduit shall be run so as not to interfere with other piping fixtures or equipment.

9. The ends of all conduit shall be cut square, carefully reamed out to full size and shall be shouldered in fitting.
10. No running threads will be permitted in locations exposed to the weather, in concrete or underground. Special union fittings shall be used in these locations.
11. Where conduit is underground, under slabs or grade, exposed to the weather, or in wet locations, make joints liquid tight and gas tight.
12. All metal conduit in masonry and concrete and where concealed under floor slabs shall have joints painted with thread compound prior to makeup.
13. PVC conduit shall not be run in walls except where approved by the Engineer prior to bid in limited instances that may include concrete or CMU walls used in site retaining, parking structures, or exterior equipment yard or enclosure walls, etc.
14. Where conductors enter a raceway or a raceway in a cabinet, pull box, junction box, or auxiliary gutter, the conductors shall be protected by a plastic bushing type fitting providing a smoothly rounded insulating surface.
15. Where conduit extends through roof to equipment on roof area, the Contractor shall provide flashing material compatible with the roofing system as required by the roofing specifications or as required by the Owner's roof warranty. This flashing shall be delivered to the roofing Contractor for installation. The actual location of all such roof penetrations and outlets shall be verified by the Architect/Owner. Contractor to verify type of flashing prior to bid and include all costs.
16. All conduit shall be supported at intervals not less than 6'-0" and within 12" from any outlet and at each side of bends and elbows. Conduit supports shall be galvanized, heavy stamped, two-hole conduit clamp properly secured.
17. Where conduit racks are used the rack shall consist of two-piece conduit clamps attached to galvanized steel slotted channels, properly secured via threaded rods attached directly to the building structure.
18. Nail-in conduit supports, one-piece set screw type conduit clamps or perforated iron for supporting conduit shall not be used.
19. Seismic Conduit Support:
    a. All conduit shall be supported in such a manner that it is securely attached to the structure of the building. Attachment is to be capable of supporting the tributary weight of conduit and contents in any direction. Maximum spacing of support and braces are to be as follows:

CONDUIT SIZE	MAXIMUM SPACING
1/2" to 3"	6'-0"
3-1/2" to 4"	8'-0"

20. All conduit runs shall be installed parallel or perpendicular to walls, structural members, or intersection of vertical planes and ceilings. Field made bends and offset shall be avoided where possible. Crushed or deformed raceway shall not be installed.
21. Open knockouts in outlet boxes only where required for inserting conduit.
22. Locate wall outlet of the same type at same level in all rooms, except where otherwise noted.
23. Outlet boxes on metal studs shall be attached to metal hangers, tack welded or screwed to studs; on wood studs attachment shall be with wood screws, nails are not acceptable.
24. Recessed boxes shall not be mounted back-to-back in any wall; minimum offset shall be 24 inches.
25. Junction Boxes that do not contain any device(s) shall be located in storage rooms, electrical closets, or above accessible ceilings, not in hard lid ceilings or other forms of inaccessible ceilings. Place boxes which must be exposed to public view in a location approved by the Owner's Project Manager. Provide covers or plates to match adjacent surfaces as approved by the Owner's Project manager.
26. Surface mounted pull boxes, terminal cabinets, junction boxes, panel boards etc., shall be attached to walls using appropriate screws, fasteners, backing plates, stud blocking etc., as detailed on architectural and/or structural drawings. If architectural and/or structural drawings are not provided on the project, Contractor shall provide all necessary mounting

hardware and backing support to comply with local building code requirements and any additional requirements imposed by the local Authority-Having-Jurisdiction.

27. Sleeves shall be installed where conduit passes through masonry or concrete walls and shall be 24-gauge galvanized steel no more than 1/2" greater in diameter than the outside diameter of the conduit. When located in non-rated structures, caulk conduit sleeve with stone wool and waterproof below grade. When located in fire rated structures, provide UL listed fire stopping system. See fire stopping section of this specification for additional requirements.
28. All boxes shall be covered with outlet box protector, Appleton SB-CK, or similar device/method to keep dirt/debris from entering box, conduit or panels. If dirt/debris does get in, it shall be removed prior to pulling wires.
29. All boxes installed outdoors shall be suitable for outdoor installations, gasketed, screw cover, and painted as directed by the Architect with weatherproof paint to match building.
30. All conduit entries to outdoor mounted panels, cabinets, boxes, etc., shall be made using Myers "SCRU-TITE" hubs Series ST.
31. Provide nylon or a 1/8-inch O.D. polyethylene rope, rated at 250 pounds tensile strength, in all conduits more than 5 feet in length left empty for future use. Not less than 5 feet of rope shall be left at each end of the conduit. Tag all lines with a plastic tag at each end indicating the termination/stub location of the opposite end of the conduit.
32. All multiple conduit runs within suspended ceilings shall be suspended from building structure by means of unistrut hangers/racks, Conduit shall not be allowed to lay on ceiling or be supported from ceiling suspension wires or other suspension system. Support conduit to structure above suspended ceilings 8" minimum above ceiling to allow removal of ceiling tile. Maintain two-inch clearance above recessed light fixtures
33. All exposed conduits and support hardware shall be painted to match the finish of the wall or ceiling to which it is supported.
34. Where conduits or wireways cross seismic joints, provide approved flexible conduit connection or approved expansion/deflection fitting to allow for displacement of conduit in all three axes. Connection shall allow for movement in accordance with design of seismic joint. Non-flexible raceways crossing expansion joints or other areas of possible structural movement shall make provision for 3-way movement at such points by means of expansion/deflection fittings. Fittings shall be installed in the center of their axes of movement and shall not be deflected to make part of a conduit bend, or compressed or extended to compensate for incorrect conduit expansion/deflection fittings(s) complete with ground jumpers. Where necessary, provide approved expansion joints to allow for thermal expansion and contraction of conduit(s). Install expansion joints complete with ground jumpers.
35. Seal all conduits where termination is subject to moisture or where conduit penetrates exterior wall, floor or roof, in refrigerated areas, classified (hazardous areas) and as indicated on the drawings.
36. Except as otherwise indicated on the Drawings or elsewhere in these specifications, bends in feeder and branch circuit conduit 2 inches or larger shall have a radius or curvature of the inner edge, equal to not less than ten (10) times the internal diameter of the conduit. Except where sweeping vertically into a building, and where sweep radius equals ten (10) times conduit diameter, underground communications and building interconnect conduits 3 inches or larger shall have a minimum 12’-6” radius or curvature of the inner edge. For the serving utilities, radius bends shall be made per their respective specifications.
37. Tag all empty conduits at each accessible end with a permanent tag identifying the purpose of the conduit, footage end-to-end, and the location of the other end. In wet, corrosive outdoor or underground locations, use brass, bronze, or copper 16-gauge tags secured to conduit ends with #16 or larger galvanized wire. Inscribe on the tags, with steel punch dies, clear and complete identifying information.
38. The following additional requirements shall apply to underground conduits:

a. Underground conduit shall be Schedule 40 PVC (polyvinyl chloride) unless otherwise indicated elsewhere in these specifications or as required per NEC, or CEC where adopted Article 517.13.
b. For all communications conduits 2" and larger and feeders 100A or greater, provide with a minimum 3" inch, (2,000 LB) concrete envelope, 2-inch minimum separation between conduits, installed at depth of not less than 24" below grade. (Provide concrete encasement and/or greater minimum conduit depth as required by the Utility Companies.) Conduit separation within a duct bank shall be maintained using plastic spacers located at 5'-0" intervals. Where power and communication conduits are run in a common trench, a 12-inch minimum separation shall be maintained between power and communication conduits or as required by Utility Companies. Where concrete encasement is not required by serving utilities for a utility-only duct bank, provide free draining sand bedding suitable to achieve 95% relative compaction based on ASTM D1557 using 6” lifts or directed by Utility Company Standards.
c. In all cases, where any conduit(s) pass under a building slab or footing, the electrical Contractor will provide a Bentonite clay or concrete barrier that conforms to the height and width of the trench excavation extending a minimum of 24” on either side of the foundation. In all cases, where conduit(s) pass through a sleeve in a footing or other foundation element, the electrical Contractor will provide a Bentonite clay or concrete barrier between the sleeve and the conduit(s) surrounding the conduit(s) for the entire depth of the sleeve. The barrier is required to prevent passage of moisture under or through the slab or footing via the trench or sleeve.
d. Where underground conduit passes under a building slab, concrete encasement may not be required, except as required above, contact the Engineer for written direction prior to omitting any encasement.
e. Underground conduits, which terminate inside building(s) below grade, such as in a basement level, or which slope so that water might flow into interior building spaces, shall be sealed at the point of penetration with a modular conduit seal (Link-Seal or equal by Rox Systems). Conduit/conduit sealing system penetrations of waterproofing membranes/systems on existing structures shall be completely restored as required to maintain membrane/system manufacturer and installer warranty for the installation. All conduits shall be provided with a 4% slope away from buildings. All conduits shall be installed such that the water cannot accumulate in the conduit and such that water drains into the nearest manhole, pull box or vault – not into the facility. In instances where grade changes or elevation differences prevent sloping of conduit away from a building into the nearest manhole, pull box or vault or where accumulation of water in a manhole, pull box or vault may result in water traveling into the facility, conduits shall be sealed internally at each end of each conduit using conduit sealing bushing, sized as required for the conductors contained within the conduit (O-Z Gedney #CSBG 100psig withstand or equal). In all cases, install plugs or caps in spare (empty) conduits at both ends of each conduit (Jackmoon or equal) preventing both water and gas from entering the facility via the conduits.
f. Include a separate insulated green ground conductor sized per NEC, or CEC where adopted, in each underground electrical feeder/branch circuit.
g. All underground conduits with circuits rated at 40As or greater and all underground communications conduits shall be provided with a metallic marker tape located 12 inches below the finished grade.
h. Where underground conduits sweep into/through slabs, utilize PVC 90 degree sweeps that transition, via female PVC adapter to GRC coupling mounted flush in slab. GRC couplings shall be 1/2 lap taped with 20-mil tape. If the distance of the conduit run between a sweep and the next connecting sweep, pullbox, vault or manhole exceeds 150 ft then the sweep shall be concrete encased. Exceptions:
    1) Communications conduits shown terminating at a finished floor shall have an additional 4” high GRC nipple equipped with a bushing, removable conduit plug, labeling tag and pull rope. Tie off pull rope to conduit plug.

2) Utility conduit sweeps shall be installed per the requirements of the respective utility company.

i. All PVC conduit shall be glued for a water and gas tight installation. The Contractor shall use appropriate solvent on all joints prior to gluing conduit and fittings together.

j. All underground conduit work shall conform to the Federal, State and Local Safety Orders or Rules regarding excavations, trenches and related earthwork. For projects in California, refer to the California Code of Regulations, Title 8, Construction Code Sections 1540 and 1541 for additional requirements.

39. Installation of Metal Clad (MC) Cable (when use is permitted in the Allowed Specification Deviations Section or Deductive/Additive Alternate Pricing Section, generally located on the symbols list drawing).

a. Provide J-box above accessible ceiling prior to running MC cable within partitions or walls. J-box shall be permanently labeled with panel identification and circuit numbers contained within.

b. Overhead MC cable runs shall generally follow building lines to provide a neat and workmanlike installation.

c. Provide code-sized J-boxes to accommodate MC cable splicing in general. For systems furniture poke-through feeds utilizing MC cable, transition from MC cables to conduit and wire near the panelboard in the TI accessible ceiling space on the floor below the panel board via code-sized gutter(s). Utilize UL listed, insulated barrier strips with recessed screw heads (Ideal #89-6?? Series or equal) fastened within the gutter(s), terminate MC conductors on one side of the strips(s) and individual conductors in conduit from the panelboard(s) on the other side of the strip(s). Label each terminal strip(s) with panel designation. Label each phase conductor with circuit number using wire markers (Ideal or equal). Wire nuts are not an acceptable alternative to the terminal strips in these underfloor transition locations. Provide (1) spare 3/4" conduit from each gutter to its respective panelboard.

d. MC cable shall not run directly into panelboards, distribution boards or electrical rooms.

e. MC cabling shall be provided with its own code-approved ceiling support wires, cable hangers, individual spring steel support clips, steel trapeze hangers, threaded roads or dedicated #10 AWG drop wire. Cable supports shall be fastened to concrete slabs, beams, joists or other structural members of the building. In no case shall MC cable rest on ceilings, suspended ceilings or structures. Do not support MC cable using ceiling support wires. The use of nylon cable ties to support MC cable is not allowed.

f. Use lock or spring nut MC cable fittings.

g. Cable runs shall be continuous from wiring device to wiring device – no intermediate splicing J-boxes allowed.

h. When terminating or splicing at a junction, outlet, or switch box, cut the cable with an armored cable rotary cutter such that 6-inches of free conductors remain for connections or splices. Use screw-in or spring lock connector and ensure a proper bonding by firmly tightening the connector to both the box and cable. Insert an anti-short bushing at cable ends to protect conductors from abrasion and use insulated connectors.

i. MC cable bend radius shall not e less than seven (7) times the external diameter of the cable.

j. MC cables passing through fire-rated walls or floors shall be firestopped as required with a UL listed system. See firestopping requirements outlined elsewhere in this specification for additional requirements.

k. Installation shall 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.

l. Maintain MC Cable clearance of at least 6 inches from hot water and any other high temperature pipes. Maintain at least 12-inches clearance between MC cable(s) and telecommunication conduits and cables. MC cable shall cross telecommunication cables and conduits at right angles.
m. MC cabling shall not be run through exposed ceilings, where open grid conditions exist, exposed on walls, or exposed to view. See Power Plan and Lighting Plan General Notes for additional requirements.

40. Installation of Electrical Nonmetallic Tubing (ENT) Cable (when use is permitted in the Allowed Specification Deviations Section or Deductive/Additive Alternate Pricing Section generally located on the symbols list drawing).
    a. When approved for use in the Allowed Specification Deviations Section or Deductive/Additive Alternate Pricing Section, generally located on the symbols list drawing, 1/2" and 3/4” trade size ENT shall be allowed for concealed lighting branch circuits, receptacle branch circuits and miscellaneous signal system circuits within concrete floors, walls and columns within parking structures.
    b. ENT conduit shall meet the requirements of Underwriters Laboratories Standards 1479 and 1655, NEMA TC-13, and be UL-listed.
    c. All ENT conduit, ENT fittings, ENT boxes and ENT accessories shall be UL listed and manufactured by the same manufacturer so as to form a complete ENT system. ENT systems shall only be used if they are listed for use in fire resistance rated concrete floors and ceilings with resistance ratings as indicated elsewhere in the project plans. ENT system shall comply with NEC, or CEC where adopted, Article 362.
    d. All ENT fittings and ENT boxes shall be concrete-tight listed without the use of tape. Additionally, ENT fittings shall be constructed of high impact PVC and able to resist ENT conduit pull out forces of a minimum of 175 lbs. ENT fittings with fewer than 6 locking tabs for ENT connection shall utilize manufacturer approved glue as additional protection from fitting/conduit separation. ENT conduit to rigid conduit transition fittings shall be equipped with set screw fittings on the rigid conduit side of the fitting. ENT to metal box fittings shall be equipped with a threaded end and lock washer.
    e. Where tubing enters a box, fitting, or other enclosure provide a bushing or adapter to protect conductors from abrasion unless the box, fitting, or enclosure design provides equivalent protection.
    f. ENT junction boxes shall have brass screw inserts and shall be rated to support lighting fixtures weighing less than 50 lbs.
    g. Concrete tight metal boxes shall be used to support pendant hung fixtures or fixtures over 50 lbs.
    h. ENT shall be provided in continuous lengths between junction boxes without use of in-line splices or connectors and shall be clearly marked/labeled at least every 10 feet.
    i. All ENT conduit containing electrical branch circuits shall contain a code-sized equipment ground conductor.
    j. ENT shall transition to EMT, IMC, RMC, or rigid PVC, as appropriate or as called out elsewhere in this specification, for all exposed conduits within/on/under a parking structure.
    k. ENT shall transition to appropriately sized PVC expansion joint(s) at all structure expansion or seismic joints.
    l. ENT shall be securely fastened and supported every 2 – 3 ft. and within 1 ft. of every junction box and fitting to prevent movement and sag.
    m. ENT shall be routed straight without sags, or excessive bending. Where bends are required, comply with Table 362.24 of the NEC for minimum radius of bends. Number of bends shall not exceed quantity allowed by code where used for power and lighting branch circuit and/or feeder conductors. Where utilized for communications system conductors (phones, data cabling, etc.) number of bends

shall not exceed the equivalent of (2) 90-degree bends with conduit length no more than 100 feet without installation of a TIA 569-compliant pull box.

n. Separation of ENT from fittings, excessive sags, or deflections in ENT runs that prevent pulling of wire and other ENT system product or system installation failures/errors shall be corrected by saw cutting and patching as necessary at no additional cost to the Owner. Use of surface mounted conduits and junction boxes as a repair method is unacceptable.

o. Empty ENT runs shall be provided with a nylon pull string.

p. Coordinate installation of raceway with structural steel and other structural members. Do not cut, notch or otherwise alter structural members without obtaining approval in writing from the Structural Engineer of record.

q. No more than (2) 3/4" ENT conduits may cross each other within a horizontal concrete slab without obtaining approval in writing from the Structural Engineer of record.

B. Installation of 600-Volt Conductors:

1. All electrical wire, including signal circuits, shall be installed in conduit.
2. All circuits and feeder wires for all systems shall be continuous from over current protective device or switch to terminal or farthest outlet. No joints shall be made except in pull, junction or outlet boxes, or in panel or switchboard gutters.
   a. Utilize preinsulated "winged" spring type connectors, 3M Company "Performance Plus" #O/B or #R/Y or equal as required for splices and taps in conductors #6 AWG and smaller. When a spring connector is used in an underground environment or when subject to moisture, utilize a 3M Company Scotchcast 3507G epoxy resin connector sealing pack to seal the spring connector. THE USE OF PUSH-WIRE CONNECTORS (e.g. "WAGO" OR EQUIVALENT) IS STRICTLY PROHIBITED.
   b. Wires #4 AWG and larger AWG shall be joined together as follows:
      1) When located in an underground environment or when subject to moisture, the splice shall be made with compression connector and sealed by a 3M, or equal, PST cold shrink connector insulator.
      2) When located in an interior environment, the splice shall be made with an Ilsco or equal dual rated, insulated splice-reducer connector or multi-tap connector-listed for use with 75/90-degree Celsius rated conductors.
   c. Connections to busbar shall be made with dual-rated copper/aluminum one-piece compression lugs. Paralleled conductor connections shall be by mechanical lugs.
3. Thoroughly clean all conduit and wire-ways and see that all parts are perfectly dry before pulling any wires.
4. Install UL approved fixture wire from all lighting fixture lamp sockets into fixture outlet or junction box.
5. For 20A branch circuit wiring, increase #12 conductors to #10 for 120-volt circuits longer than 100 feet and for 277V circuits longer than 150 feet.
6. Conductor Support: Provide conductor supports as required by codes and recommended by cable manufacturer. Where required, provide cable supports in vertical conduits and provide lower end of conduit with a ventilator.

C. Grounding/Bonding:

1. Provide grounding and bonding for entire electric installation as shown on plans, as listed herein, and as required by applicable codes. Included, but not limited to, are items that require grounding/bonding:
   a. Conduit, Raceways and Cable Trays.
   b. Neutral or identified conductors of interior wiring system.
   c. Panel boards, Distribution Boards, Switchgear and Switchboards.
   d. Non-current carrying metal parts of fixed equipment.
   e. Telephone distribution equipment.
   f. Transformers, Inverters, UPS, PDU, RDC, Transfer Switch and Generator Systems.
   g. Raised Flooring.

h. Exposed metal in maintenance holes, hand holes.
i. Lightning Protection Systems and Antennas.
j. Metal piping installed in or attached to a building/structure.
k. Metallically isolated structural steel.
l. Metallically isolated underground metal water piping.
m. Elevator hydraulic piston/lift case.

2. In multi-occupancy buildings, Contractor shall bond metal water piping systems instated in, under or attached to a building and/or structure serving individual occupancies where the piping system(s) are metallically isolated from each other. Per NEC, or CEC where adopted ART. 250.104(A)(2) and (4), the bonding conductor shall be sized per Table 250.122 and connected to the switchboard/panel board serving that suite/occupancy.
3. Use of Ground Rods: Furnish and install required number of 3/4" x 10' copper clad ground rods to meet specified resistance, all required grounding wires, conduit and clamps. The size of the grounding conductors shall be not less than that set forth in the latest edition of the California Code of Regulations, Title 24, State of California and NEC (CEC, where adopted), unless otherwise indicated. Rods shall be installed such that at least 10 feet of length is in contact with the soil. Where rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from vertical or shall be buried in a trench that is at least 30 inches deep. The upper end of the electrode shall be flush with or below ground level unless the above ground end and the grounding electrode conductor attachments are protected against physical damage. Unless otherwise noted, connection to the grounding electrode conductor may be by compression type or exothermic process connector. Mechanical connectors shall not be used.
4. Grounding System Connection:
   a. Compression connectors shall be unplated copper, manufactured by Burndy, or approved equal, designed specifically for the intended connection.
   b. Exothermic weld-type connectors shall be ‘Cadweld’ manufactured by Erico Products, or approved equal, designed specifically for the intended connection.
   c. Mechanical connectors shall not be used.
5. Isolated Ground Receptacles shall have an insulated ground wire connected between the receptacle and the panelboard isolated ground bus. Unless otherwise noted, this ground wire shall not be grounded at any other point, and shall be distinguished from other ground wires by a continuous yellow stripe.
6. Provide separate green equipment ground conductor in all electrical raceways to effectively ground all fixtures, panels, controls, motors, disconnect switches, exterior lighting standards, and noncurrent carrying metallic enclosures. Use bonding jumpers, grounding bushings, lugs, busses, etc., for this purpose. Connect the equipment ground to the building system ground. Use the same size equipment ground conductors as phase conductors, up through #10 AWG. Use NEC (or CEC where adopted) Table 250.122 for conductor size with phase conductors #8 and larger, if not shown on the Drawings.
7. Clean the contact surfaces of all ground connections prior to making connections.
8. Ductwork: Provide a flexible ground strap, No. 6 AWG equivalent, at each flexible duct connection at each air handler, exhaust fan, and supply fan, and install to preclude vibration.
9. Motors: Connect the ground conductor to the conduit with an approved grounding bushing, and to the metal frame with a bolted solderless lug. Bolts, screws and washers shall be bronze or cadmium plated steel.
10. Building grounding system resistance to ground shall not exceed 25 ohms unless otherwise noted and should be confirmed by testing.

D. Line Voltage and Low Voltage Power Supplies to all Mechanical Equipment Including Plumbing, Heating and Air Conditioning Units:
   1. An electric power supply, including conduit, any necessary junction and/or outlet boxes and conductors and connection shall be furnished and installed by the Contractor for each item or mechanical equipment.

2. Power supplies to individual items of equipment shall be terminated in a suitable outlet or junction box adjacent to the respective item of equipment, or a junction box provided by the manufacturer or the equipment and directed by the Mechanical Contractor. Allow sufficient lengths of conductor at each location to permit connection to the individual equipment without breaking the wire run.
3. The location of all conduit terminations to the equipment is approximate. The exact location of these conduit terminations shall be located and installed as directed by the Mechanical and Plumbing Contractor.
4. Provide power supplies to all plumbing and mechanical equipment, including but not limited to, equipment furnished and installed by Owner or Contractor such as heating and air conditioning equipment, pumps, boilers, auto valves, water coolers, trap primers etc. The installation shall produce a complete and operable system.
5. Unless otherwise noted, the Contractor shall furnish and install all conduit, boxes, wires, etc., for line voltage wiring and low voltage wiring.
6. It is the Contractor's responsibility to verify with the drawings of other trades regarding the extent of his responsibility for mechanical equipment. The bid must include a sum sufficient to cover the cost of the installation.
7. The location of all power supply connection and/or terminations to the mechanical equipment is approximate. The exact locations of these terminations shall be verified with other trades during construction.

E. Prefabricated Equipment: Installation of all prefabricated items and equipment shall conform to the requirements of the manufacturer's specifications and installation instruction pamphlets. Where code requirements affect installation of materials and equipment, the more stringent requirements, code or manufacturer's instructions and/or specifications, shall govern the work.

F. Firestopping:
1. The Contractor shall be responsible for furnishing all material, labor, equipment, and services in conjunction with the selection and installation of a complete, fully functioning, code compliant, UL-listed, fire stop assembly/system(s) as required by project conditions.
2. Each fire stop assembly/system shall have an "F" and/or "T" rating as required by each condition requiring fire stopping. Each fire stop assembly/system shall have a current UL listing, as indicated in the latest edition of the UL Fire Resistance Directory. Contractor shall verify acceptability of all fire stopping methods and system selections with the authority having jurisdiction prior to installation. The Contractor shall install each fire stop assembly/system in accordance with the manufacturer's printed instructions.
3. Each fire stop assembly/system shall be labeled with fire stop manufacturer-furnished label on each side of the fire stopping systems depicting UL # etc.

G. Housekeeping Pads
1. Provide a minimum 3" high housekeeping pad above finished floor/finished grade for all floor-mounted switchgear, switchboards, distribution boards, transformers, motor control centers, etc., flush with the face of the equipment. Located in mechanical central plant(s), other mechanical spaces, and located outdoors, pads shall be flush with the face of the equipment. Confirm pad dimensions with local inspector prior to forming pad to ensure any local code interpretations/conditions are met regarding housekeeping pads.
2. Unless otherwise noted above, provide a minimum 1-1/2" high housekeeping pad above finished floor/finished grade for all interior floor-mounted switchgear, switchboards, distribution boards, transformers, motor control centers, transfer switches etc., flush with the face of the equipment. All housekeeping pad heights are as measured from finished floor or grade. Confirm pad dimensions with local inspector prior to forming pad to ensure any local code interpretations/conditions are met regarding housekeeping pads.
3. Provide a 1-1/2" high housekeeping pad above finished floor/finished for service equipment. Prior to pad rough-in, Contractor shall verify serving utility company's maximum meter height requirements and, if necessary, adjust height of housekeeping pad to comply with those requirements. In indoor applications, the pad shall be flush with the face of the switchgear. In outdoor applications, the housekeeping pad shall extend a

minimum of 4 feet from the front of switchgear/switchboard's weatherproof enclosure. Confirm pad dimensions with local inspector prior to forming pad to ensure any local code interpretations/conditions are met regarding housekeeping pads.

4. All housekeeping pads located in, on or attached to a building shall be seismically braced/connected to the building structure.

END OF SECTION 26 0000

SECTION 27 0526

GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This Section (27 0526) includes the specifications for:
   1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on drawings
   2. The testing, documentation and instructions for completing the Grounding and Bonding for Communications Systems
   3. Products supplied but not installed under this section, including:
      a. Loose equipment, specified herein, which is to be turned over to the owner at the completion of this project
      b. Bonding busbars, specified herein, to be turned over to the Electrical Contractor for installation

B. Related Drawings
   1. T-Series drawings follow the specifications in this Section.
   2. Electrical drawings specify the electrical requirements.
   3. Interior Design drawings specify the interior finishes, spatial relationships between items, and specific mounting heights.

C. What the Contractor Shall Provide and Install
   1. Although such work is not specifically mentioned herein or on the drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.
   2. The Contractor shall provide system testing and demonstration, system documentation, and instruction of Owner personnel, without claim for additional payment.

D. Errors or Omissions in Drawings or Documentation
   1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.
   2. Should conflict occur in or between drawings and specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained a written decision (addendum), before the submission of the bid, as to which method or materials will be required.

E. Dimensions
   1. The dimensions indicated are limiting dimensions.
   2. Do not use equipment exceeding the dimensions indicated.
   3. Do not use equipment or arrangements that reduce the required clearances or exceed the specified maximum dimensions.

1.02 REFERENCES

A. Requirements, Codes, and Standards

B. Design, manufacture, test, and install telecommunications cabling networks per the manufacturer's requirements and in accordance with the latest revision of NFPA-70 (the National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJ), and the following standards, including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) released at the time of bid, including:
   1. TIA-607 – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
   2. IEEE C2-2012, National Electrical Safety Code® (NESC®)

3. IEEE 1100-2005, Recommended Practice for Powering and Grounding Electronic Equipment
4. NFPA – National Electrical Code® (NEC®)

C. BICSI® Publications

D. Install cabling in accordance with the most recent edition of the following BICSI® publications:
1. BICSI – Telecommunications Distribution Methods Manual
2. BICSI – Information Technology Systems Installation Manual
3. BICSI – Outside Plant Design Reference Manual

E. Applicability of Codes, Rules, and Regulations
1. Federal, state, and local codes, rules, regulations, and ordinances governing the work are as fully part of the specifications as if herein repeated or hereto attached.
2. If the Contractor notes items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's representative in writing.
3. Where the requirements of other Sections of the specifications are more stringent than the applicable codes, rules, regulations, and ordinances, the specifications shall apply.

F. Manufacturers' Recommendations

G. To maintain the applications warranties, install all cabling and termination devices using the manufacturers' recommended installation practices.

H. Definitions

I. The following are the definitions of the terms used in this Section:
1. AWG – American Wire Gauge – The standardized system for gauging the diameter of round, solid, non-ferrous, electrically-conducting wire.
2. BBC – Bonding Backbone Conductor – A telecommunication bonding connection which interconnects telecommunications bonding backbones. Formerly known as the grounding equalizer.
3. BN – Bonding Network – A set of interconnected conductive structures that provides a low impedance path for the associated telecommunications infrastructure.
4. CP – Consolidation Point – A connection facility within Cabling Subsystem 1 for interconnection of cables extending from building pathways to the equipment outlet.
5. EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless that includes the entrance point of the building and continues to the entrance room or space. Also known as an MPOE (Minimum Point of Entry).
6. ER – Equipment Room – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment.
7. ESD – Electro Static Discharge – The sudden flow of electricity between two electrically-charged objects caused by contact, an electrical short, or dielectric breakdown.
8. HC – Horizontal Cross-connect – A group of connectors, such as patch panels or punch-down blocks, that allow horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers.
9. HDA – Horizontal Distribution Area – A space in a computer room where a Horizontal Cross-connect (HC) is located and which may include LAN switches, Storage Area Network (SAN) switches, and Keyboard/Video/Mouse (KVM) switches for the end equipment located in the equipment distribution areas.
10. IC – Intermediate Cross-connect – A facility enabling the termination of different levels of backbone cabling and interconnection between them or equipment.
11. MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling, or equipment.

12. MDA – Main Distribution Area – The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC).
13. PBB – Primary Bonding Busbar – A busbar placed in a convenient and accessible location and bonded, by means of the Telecommunications Bonding Conductor (TBC), to the building's service equipment (power) ground. Formerly known as the Telecommunications Main Grounding Busbar (TMGB).
14. RBB – Rack Bonding Busbar – A busbar within a cabinet, frame, or rack.
15. RBC – Rack Bonding Conductor – A bonding conductor from the rack or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).
16. RU – Rack Unit – A unit of measure, compliant with EIA 310, used to describe the height of equipment intended for mounting on equipment rails. One RU is 1.75 inches (44.45 mm) high.
17. SBB – Secondary Bonding Busbar – A common point of connection for telecommunications system and equipment bonding to ground, located in the distributor room. Formerly known as the Telecommunications Grounding Busbar (TGB).
18. TBB – Telecommunications Bonding Backbone – The conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).
19. TBC – Telecommunications Bonding Conductor – A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.
20. TEBC – Telecommunications Equipment Bonding Conductor – A conductor that connects the Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) to equipment racks or cabinets.
21. TO – Telecommunications Outlet – A connecting device, located in a work area, at which the horizontal cabling terminates.
22. TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. It is the recognized location of the cross-connect between the backbone and horizontal facilities. Also known as an IDF (Intermediate Distribution Frame).
23. UBC – Unit Bonding Conductor – A bonding conductor from equipment or a patch panel to a Rack Bonding Conductor (RBB) or a Rack Bonding Busbar (RBB).
24. ZDA – Zone Distribution Area – A space where a zone outlet or consolidation point is located, between the horizontal and equipment distribution areas, that allows frequent reconfiguration and flexibility.

1.03 SUBMITTALS

A. Engineer's Review
   1. The Engineer's review of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the contract documents.
   2. The Contractor shall include, with the shop drawings, an index sheet detailing all deviations from the contract documents and will be held responsible for all deviations, unless the Contractor has received written approval from the Engineer for the specific deviation, separate from general shop drawing approval.
   3. The Engineer's review shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

B. For all products, the Contractor shall submit the following data for each component covered under this Section:
   1. A Specification Section reference
   2. The Manufacturer's name
   3. The Manufacturer's model number and part number

1.04 QUALITY ASSURANCE

A. Standards for Materials and Equipment

1. The Contractor shall provide all materials and equipment, and shall install them in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.
2. The Contractor shall provide all electronic equipment with the UL label when applicable.

B. Installer Qualifications
1. Registered Communications Distribution Designer (RCDD)
2. The Contractor must have at least one (1) Registered Communications Distribution Designer (RCDD) as recognized by Building Industry Consulting Service International (BICSI). The RCDD must be a full-time employee of the Contractor, and shall be responsible for the compliance of work with the referenced standards and guidelines. At the time of bid, the RCDD shall provide a professional resume and proof of current registration to the Engineer for approval. The RCDD shall be present during construction and all cable testing and shall have:
   a. Knowledge of BICSI installation standards
   b. Knowledge of NEC standards
   c. Knowledge of ANSI/TIA standards

C. Compliance with Laws, Ordinances, and Codes
1. Comply in every way with the requirements of local laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. Anything in the plans or specifications that does not strictly comply with the above laws, ordinances, and rules must be referred to the attention of the Engineer for a decision before proceeding. No change in the plans or specifications shall be made without full consent, in writing, of the Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handling
1. To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling.

B. Storage
1. The Contractor shall coordinate the secure storage of equipment and materials on site or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense.
2. Do not store equipment where conditions fall outside manufacturer's recommendations for environmental conditions.
3. Do not install damaged equipment. Remove damaged equipment from the site, and replace it with new equipment.
4. If off-site storage of materials is necessary, this shall be at the Contractor's expense.

1.06 COORDINATION

A. Installation Schedule
1. The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 10 days of contract award.

B. Final Inspection
1. The Contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment.

1.07 PROJECT CONDITIONS

A. Existing Conditions
1. Verify that all conditions on the project site applicable to the Work specified in this Section are as documented and are appropriate for the Work. Prior to bid opening, notify the Consulting Engineer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.
2. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make

recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner.

B. Record Drawings
   1. Keep a complete set of all telecommunications drawings in the job site office for demonstration of actual installation work under this Section.
   2. Use this set of drawings for no other purpose.
   3. When any material, equipment, or system components are installed differently than what is shown on the drawings, indicate the differences clearly and neatly using ink or indelible pencil.
   4. Upon completion of the project, submit the record set of drawings.

1.08 USE OF THE SITE

A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.

B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.

C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on how and when to work in these areas.

D. Multiple times each day, each contractor shall remove all trash and debris from the site.

E. Before leaving the site each day:
   1. The Contractor shall replace all ceiling tiles that they have removed.
   2. The Contractor shall place all furniture and equipment that they have moved back into its original location.
   3. The Contractor shall return any equipment that they have disconnected to working order.
   4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.

1.09 CONTINUITY OF SERVICES

A. Take no action that will interfere with or interrupt the existing building services unless previous arrangements have been made with the Owner's representative. Arrange all work to minimize shutdown time.

B. The Owner's personnel shall perform shutdown of all operating systems. When shutdown of systems is required, the Contractor shall give a minimum of five (5) days advance notice.

C. Should building services be inadvertently interrupted:
   1. The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services.
   2. The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner.

1.10 WARRANTY

A. The Contractor shall provide the following warranties for the system and components.
   1. Contractor Materials and Labor Warranty
   2. The Contractor shall provide system warranties, for a period specified in the contract documents, against faulty materials and defects in workmanship. The Contractor shall also honor any manufacturer warranties that exceed this period of time.
   3. Manufacturer Component Warranty
   4. All components of the grounding and bonding system shall be free from manufacturing defects in material or workmanship, under normal and proper usage, for a minimum of one (1) year.

B. The Manufacturer shall bear the burden to replace or repair any defective products during the warranty period at their cost, including labor and materials.

C. The warranty period shall begin on the date of the Owner's Acceptance of the Work. Evaluation of quality and workmanship shall be solely by the Owner or the Owner's representatives.

1.11 COMMISSIONING

A. Furnish one initial set of product brochures and owner's manuals to the Architect for use during acceptance testing and equalization.

PART 2 PRODUCTS

2.01 GENERAL NOTES

A. In this section, certain products are specified by manufacturer and part number to establish a level of quality, performance, and consistency. If no manufacturer or part number is specified for a part, then that part is generic, and the Contractor shall submit for approval a part that provides the performance specified herein.

B. All products shall be new, of the latest version at time of bid, and brought to the job site in the original manufacturer's packaging. Electrical components shall bear the UL or ETL label, and this listing requirement shall apply to the entire assembly. Only systems and equipment that meet or exceed the level of quality and the capabilities stated in this document will be considered for acceptance. Used equipment or damaged material will be rejected.

C. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

D. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.

E. All components will be approved by the Engineer and shall have the highest aesthetic value possible while providing the specified functionality. Hardware shall:
   1. Be in compliance with the Construction Documents
   2. Have fit and finish compatible with the existing surrounding structure
   3. Provide the required functionality

F. Fabricate custom-made equipment with careful consideration given to the aesthetic, technical, and functional aspects of the equipment and its installation.

G. Provide products that are suitable for the intended use, for the environment in which they are to be installed, that meet regulatory requirements, and that comply with applicable electrical codes.

2.02 EARTHING AND BONDING MATERIALS

A. The Primary Bonding Busbar (PBB) shall be:
   1. A solid, tinned copper bar, 4 inches wide by 20 inches long by 1/4 inch thick
   2. Manufactured with holes evenly spaced horizontally and vertically throughout in accordance with the pattern specified by ANSI/TIA 607
   3. Equipped with isolated mountings that provide a 2 inch standoff from the wall

B. The Secondary Bonding Busbar (SBB) shall be:
   1. A solid, tinned copper bar, 2 inches wide by 10 inches long by 1/4 inch thick
   2. Manufactured with holes evenly spaced horizontally and vertically throughout in accordance with the pattern specified by ANSI/TIA 607
   3. Equipped with isolated mountings that provide a 2-inch standoff from the wall

C. Grounding Busbar for Racks and Enclosures

D. With each enclosure and rack, provide a tinned copper busbar to serve as an extension of the PBB or SBB for the equipment in the cabinet. The busbar shall:
   1. Be manufactured from copper alloy
   2. Be at least .75 inches (19 mm) wide, 19 inches (483 mm) long, and 0.1875 inches (5 mm) thick
   3. Have at least 14, factory-provided #12-24 threaded holes
   4. Have pre-punched EIA 310 D mountings, which match that of the vertical rail, for attachment to the mounting rail
   5. Be at least 0.67 inches (17 mm) wide, 78.65 inches (2 m) long, and 0.05 inches (1.27 mm) thick

6. Include a hardware kit with rack installation hardware and with screws for bonding equipment to the busbar

E. The Telecommunications Bonding Conductor (TBC) shall be a UL listed, stranded conductor insulated with a green jacket. The TBC shall be equal in size to the TBB specified elsewhere in this Section.

F. The Telecommunications Bonding Backbone (TBB) shall be a UL-listed insulated earthing conductor sized as shown in the contract drawings.

G. The Equipment Bonding Conductors (EBCs) shall be #6AWG or larger stranded conductor with a green insulating jacket.

H. All bonding lugs shall be listed, and of the permanent two-bolt irreversible compression fitting type.
   1. Lugs shall be constructed of tinned copper.
   2. Barrels shall be color-coded with an inspection window.
   3. Lugs shall comply with NEBS 3 requirements.

I. All taps shall be permanent compression type “C” or “H” taps.

2.03 ARMORED AND SHIELDED CABLE BONDING

A. Patch panels for use with shielded cabling in cabinets and racks shall be bonded to the supplemental telecommunications bonding system.

B. Armored or sheathed cable that does not have a metal jack or a means of electrically-continuous connection to the patch panel or equipment must have an individual jumper to tap into the armor or sheathing and to properly bond it to the supplemental telecommunications bonding system.

C. Armored or sheathed cable with a metal jack or means of electrically-continuous connection to the patch panel or equipment does not need to be individually bonded. However, the equipment must then be properly bonded back to the PBB or SBB via one of the following methods:
   1. Bond a jumper from the equipment or cable, via an irreversible compression connection, to a Rack Bonding Conductor (RBC) that is connected to the Telecommunications Equipment Bonding Conductor (TEBC) that is bonded to the PBB or SBB.
   2. Bond equipment via a jumper, with a 2 hole grounding lug, to a Rack Bonding Busbar (RBB) (vertical or horizontal) that is properly bonded to the TEBC and to the PBB or SBB.
   3. If the equipment is electrically continuous and the rack is electrically continuous and bonded back to the TEBC or directly to the PBB or SBB, bond equipment to the rack via bonding hardware.
   4. If the equipment has a 2-hole grounding lug landing area, then to comply with equipment manufacturers’ warranties, the landing area must be properly bonded back to the busbar.

PART 3 EXECUTION

3.01 GENERAL

A. Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer.

B. Provide any necessary screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. necessary to facilitate the installation of the supplemental telecommunications bonding system.

C. Furnish any special installation equipment or tools necessary to properly complete the installation.

D. Any active equipment that does not have a built-in grounding terminal must include at least one thread-forming bonding screw or cage nut screw to bond that equipment to the rail on which it is being mounted.

E. Failure to follow the appropriate guidelines may require the installer to provide the additional material and labor required to bring the installation back into alignment with the guidelines.

F. All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify performance characteristics that meet ANSI/TIA-568 Standards, provide all Original Equipment Manufacturer (OEM) documentation to the Owner.

G. All techniques and fixtures used in the installation must allow for easy maintenance of, and ready access to, all components for test measurements.
H. No self-tapping screws shall be used.
I. All parts shall be made of corrosion-resistant material, such as plastic, anodized aluminum, or brass.
J. All materials used in the installation shall be resistant to fungus growth and moisture deterioration.
K. To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar with an inert dielectric material.

3.02 EARTHING AND BONDING

A. All bonding conductors, except Equipment Bonding Conductors (EBCs), installed as part of the supplemental telecommunications bonding system (earthing) shall be terminated to appropriately-sized two-hole compression rings or lugs. The routing of all conductors must be in lines as straight as possible (horizontal and vertical). To prevent undue deformation of the conductors, all changes in direction must have a minimum bend radius equal to four times the outer diameter of the conductor.
B. The TBC shall be provided from the building grounding electrode system in the electrical service entrance to the PBB, located in the Telecommunications Service Entrance Room (SE), by a tradesperson licensed by the Authority Having Jurisdiction.
C. A second bonding conductor will be installed from the PBB to a metallic structural element, which is effectively grounded, if available. The contractor shall coordinate with the Electrical Engineer to ensure available structural elements are effectively grounded. The use of interior water pipe system as a second bonding point is prohibited.
D. Install the PBB and SBBs in areas that are readily-accessible and are at convenient working heights above the finished floor. They must be fastened to the wall at all of the manufacturer-provided points on the standoffs using fasteners of the appropriate size and type. If attachment point is drywall, first mount a piece of 18 inch by 4 inch by ¾ inch fire-rated AC plywood to the framing members, attaching in at least four places, then attach the SBB standoffs to the plywood backing.
E. In each equipment rack and cabinet, install a tinned copper busbar to the front mounting rails using fasteners provided by the equipment rack manufacturer.
F. Install the TBB between the PBB in the ER, and the SBB in each TR. The TBB shall be a #3/0 AWG or larger stranded conductor, and it must be sized to ensure a maximum DC resistance of five ohms (5 Ω) from each SBB to the building earthing electrode system.
G. Within each TR and the data center, have a tradesperson licensed by the Authority Having Jurisdiction bond the SBB to the TBB by means of an appropriate “C” type tap, using a #1 AWG or larger tap conductor, and to the electrical service earth at the nearest panel board.
H. Install a single EBC from the SBB in the data center to the EGB. The EBC shall:
    1. Be UL-listed
    2. Thermoplastic High Heat-resistant Nylon-coated (THHN)
    3. Stranded #6 AWG or larger
    4. Insulated with a green jacket
    5. Terminated to a two-hole compression lug at each end
    6. Fastened with appropriate fasteners
I. Bond all metallic equipment housings, enclosures, and cables shields contained in or terminated to an enclosure or relay rack to the mounting rails using a UL-listed THHN #12 AWG stranded conductor, insulated with a green jacket, and terminate it to a single-hole compression lug at each end, or bond it to the EGB using green paint-piercing conductive screws.
J. Ground the shields of cables on one end only in accordance with ANSI/TIA 607 B.
K. Use #6 AWG or larger stranded bonding conductors that have a green jacket and are fitted with permanent 2 hole compression lugs.

L. Use bonding conductors of sufficient length to be mechanically fastened to each rack, frame, and cabinet and the associated SBB.
M. When racks, frames, and cabinets are ganged together, do not serially bond (or daisy chain) them together. Provide each rack, frame, and cabinet with its own bonding conductor from the associated SBB that is a #6 AWG or larger stranded insulated bonding bus. Tap it using permanent irreversible compression taps.
N. Mechanically fasten the end of the bonding conductor to the frame or rail of the rack, frame, or cabinet using two (2) flush fitting machine screws, star-washers, and nuts.
O. To prevent abrasion to cables, install screws placed on the interior face so that they are flush.
P. Treat dissimilar metals with anti-corrosion compounds.
Q. To ensure electrical continuity throughout the entire length of overhead metallic pathways, provide and install bonding conductors between each section of cable tray, on the exterior face of the lateral member of one side.
R. Provide and install bonding conductors as listed for overhead metallic basket-type tray pathways.
S. At the top of all conduit stub-ups (above the finished ceiling) greater than 36 inches (1 m) long, install appropriately-sized conduit bonding clamps.
T. On the corridor side of each sleeve greater than 36 inches long, install an appropriately-sized conduit bonding clamp.

END OF SECTION 27 0526

SECTION 27 0528

PATHWAYS FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This Section (27 05 28) includes the specifications for cable pathway systems.

B. The materials and labor required for the installation of cable pathway systems include, but are not limited to:
   1. Conduit
   2. Cable runway or cable tray
   3. Welded wire basket tray
   4. Non-continuous cable supports
   5. Nonmetallic cable duct

C. Related Drawings
   1. T Series drawings

D. Furnish and install telecommunications pathways, including:
   1. Conduit
   2. Cable runway or cable tray
   3. Welded wire basket tray
   4. Non-continuous cable supports
   5. Nonmetallic cable duct

E. What the Contractor Shall Provide and Install
   1. Although such work is not specifically mentioned herein or on the drawings, the Contractor shall furnish and install, without claim for additional payment:
   2. All miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation
   3. Accessories and equipment items needed for a complete system

F. Errors or Omissions in Drawings or Documentation
   1. If any errors or omissions appear in Drawings, Specifications, or other documents, bidding Contractor shall notify Engineer no later than ten (10) days prior to submitting bid.
   2. Should conflict occur in or between drawings and specifications, bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum), before submission of bid, as to which method or materials will be required.

G. Dimensions
   1. The dimensions indicated are limiting dimensions.
   2. Do not use equipment exceeding dimensions indicated.
   3. Do not use equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.

1.02 REFERENCES

A. Requirements, Codes, and Standards
   1. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with latest revision of the NFPA-70 (the National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJs), and the following standards, including the most current revisions, addenda, and any Technical Service Bulletins (TSB's) released at the time of bid, including:
   2. ANSI/NECA/BICSI-568-2006 -- Standard for Installing Commercial Building Telecommunications Cabling

3. ANSI/NECA/BICSI 607-2011 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
4. ANSI/BICSI- 002-2011 Data Center Design and Implementation Best Practices
5. TIA-569 -- Commercial Building Standard for Telecommunications Pathways and Spaces
6. TIA/EIA-606 -- Administration Standard for Commercial Telecommunications Infrastructure
7. TIA-607 – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
8. TIA-942 – Telecommunications Infrastructure Standard For Data Centers
9. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
   ASTM A 653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process
10. ASTM A 510 – Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
11. NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems
12. NEMA VE 2-2002 – Cable Tray Installation Guidelines
13. ASTM A 641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
14. IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management
15. ASTM D 3363 - 05 Standard Test Method for Film Hardness by Pencil Test

B. Applicability of Codes, Rules, and Regulations

C. Federal, state, and local codes, rules, regulations, and ordinances governing the work are as fully part of the specifications as if herein repeated or hereto attached. If the Contractor notes items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the 'Owner's representative in writing. Where the requirements of other sections of the specifications are more stringent than the applicable codes, rules, regulations, and ordinances, the specifications shall apply.

D. Manufacturers' Recommendations

E. To maintain the applications warranties, install all pathways per the manufacturers' recommended installation practices.

F. Definitions

G. The following are the definitions of the terms used in this Section:
   1. AWG – American Wire Gauge – The standardized system for gauging the diameter of round, solid, non-ferrous, electrically-conducting wire.
   2. BBC – Bonding Backbone Conductor – A telecommunication bonding connection which interconnects telecommunications bonding backbones. Formerly known as the grounding equalizer.
   3. BD – Building Distributor – A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made.
   4. BN – Bonding Network – A set of interconnected conductive structures that provides a low impedance path for the associated telecommunications infrastructure.
   5. CP – Consolidation Point – A connection facility within Cabling Subsystem 1 for interconnection of cables extending from building pathways to the equipment outlet.
   6. EDA – Equipment Distribution Area – A space allocated for end equipment, including computer systems and telecommunications equipment.
   7. EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless that includes the entrance point of the building and continues to the entrance room or space. Also known as the Minimum Point of Entry (MPOE).
   8. Data Center – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment.

9. ESD – Electro Static Discharge – The sudden flow of electricity between two electrically-charged objects caused by contact, an electrical short, or dielectric breakdown.
10. HC – Horizontal Cross-connect – A group of connectors, such as patch panels or punch-down blocks, that allow horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers.
11. HDA – Horizontal Distribution Area – A space in a computer room where a Horizontal Cross-connect (HC) is located and which may include LAN switches, Storage Area Network (SAN) switches, and Keyboard/Video/Mouse (KVM) switches for the end equipment located in the equipment distribution areas.
12. IC – Intermediate Cross-connect – A facility enabling the termination of different levels of backbone cabling and interconnection between them or equipment.
13. MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling, or equipment.
14. MDA – Main Distribution Area – The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC).
15. PBB – Primary Bonding Busbar – A busbar placed in a convenient and accessible location and bonded, by means of the Telecommunications Bonding Conductor (TBC), to the building's service equipment (power) ground. Formerly known as the Telecommunications Main Grounding Busbar (TMGB).
16. RBB – Rack Bonding Busbar – A busbar within a cabinet, frame, or rack.
17. RBC – Rack Bonding Conductor – A bonding conductor from the rack or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).
18. RU – Rack Unit – A unit of measure, compliant with EIA 310, used to describe the height of equipment intended for mounting on equipment rails. One RU is 1.75 inches (44.45 mm) high.
19. SBB – Secondary Bonding Busbar – A common point of connection for telecommunications system and equipment bonding to ground, located in the distributor room. Formerly known as the Telecommunications Grounding Busbar (TGB).
20. TBB – Telecommunications Bonding Backbone – The conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).
21. TBC – Telecommunications Bonding Conductor – A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.
22. TEBC – Telecommunications Equipment Bonding Conductor – A conductor that connects the Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) to equipment racks or cabinets.
23. TO – Telecommunications Outlet – A connecting device, located in a work area, at which the horizontal cabling terminates.
24. TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. It is the recognized location of the cross-connect between the backbone and horizontal facilities. Also known as an Intermediate Distribution Facility (IDF).
25. UBC – Unit Bonding Conductor – A bonding conductor from equipment or a patch panel to a Rack Bonding Conductor (RBB) or a Rack Bonding Busbar (RBB).

1.03 SYSTEM DESCRIPTION

A. Pathways and Raceways
   1. Pathways and Raceways are the support system for the infrastructure. All pathways and raceways shall conform to the TIA-569-B Commercial Building Standard for Pathways and Spaces. All horizontal and backbone cable shall be properly supported every 48" to 60" inches. Infrastructure Support Systems include, but may not be limited to, the following:
      a. Wire Basket Cable-trays, which shall be properly supported
      b. Conduits, both inside or outside, both above ground or underground, all of which shall be properly supported

c. Non-continuous cable supports, which shall be spaced no more than 60” inches apart
d. Surface Raceway systems, which are to be non-metallic raceways and boxes

2. A combination of cable tray, conduit, and non-continuous cable supports are preferred. Cable-trays shall be used for main corridor cable pathways on all levels. The primary cable routes will be located over corridors for easy maintenance and access.
3. To protect all cables from damage and to provide a suitable aesthetic appearance in areas where the cable may be exposed, such as in rooms with open-ceilings, conduit or surface raceway must be used instead of non-continuous cable supports.
4. Conduit routes shown on the project drawings are indicative of the design intent and desired routing. The Contractor is responsible for detailed routing within the facility and shall coordinate the detailed routing with the Owner.

1.04 SUBMITTALS

A. Engineer’s Review
1. The Engineer’s review of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the contract documents.
2. The Contractor shall include, with the shop drawings, an index sheet detailing all deviations from the contract documents and will be held responsible for all deviations, unless the Contractor has received written approval from the Engineer for the specific deviation, separate from general shop drawing approval.
3. The Engineer’s review shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

B. For all products, the Contractor shall submit the following data for each component covered under this Section:
1. A Specification Section reference
2. The Manufacturers name
3. The Manufacturers model number and part number
4. Data sheets
5. Specifications, including size, construction, and finish
6. Fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements, designating components and accessories, including clamps, brackets, hanger rods, splice connectors, straight lengths, and fittings
7. Coordination drawings, including floor plans and sections drawn to scale, on which the following items are shown and coordinated with each other using input from installers:
a. A scaled cable tray layout that includes the relationships between components and adjacent structural, electrical, and mechanical elements
b. Vertical and horizontal offsets and transitions
c. Clearances for access above and to the side of cable trays
d. Vertical elevation of cable trays above the floor or below the bottom of the ceiling structure

1.05 QUALITY ASSURANCE

A. Standards for Materials, Equipment, and Installation
1. The Contractor shall provide all materials and equipment. Installation shall be in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.
2. NEMA Compliance
3. All materials, equipment, and installation shall comply with the following NEMA standards:
a. NEMA Standards Publication Number VE1, “Cable Tray Systems”
b. NEMA Standards Publication Number VE2, “Cable Tray Installation Guidelines”
4. NEC Compliance
5. All materials, equipment, and installation shall comply with NEC Article 318, as applicable to construction and installation of cable tray and cable channel systems.

B. UL Compliance
   1. The Contractor shall provide products that are UL classified and labeled.

C. NFPA Compliance
   1. The Contractor shall comply with all NFPA 70B, “Recommended Practice for Electrical Equipment Maintenance” standards pertaining to installation of cable tray systems.

D. TIA-569-B Compliance
   1. The Contractor shall comply with Telecommunications Industry Association TIA-569-B “Commercial Building Standards for Telecommunications Pathways and Spaces.”

E. BICSI TDMM Compliance
   1. The Contractor shall comply with Building Industry Consulting Service International’s (BICSI’s) Telecommunications Distribution Methods Manual (TDMM).

F. Installer Qualifications:
   1. Registered Communications Distribution Designer (RCDD)
   2. The Contractor must have at least one (1) Registered Communications Distribution Designer (RCDD) as recognized by Building Industry Consulting Service International (BICSI). The RCDD must be a full-time employee of the Contractor, and shall be responsible for the compliance of work with the referenced standards and guidelines. At the time of bid, the RCDD shall provide a professional resume and proof of current registration shall be supplied to the Engineer for approval. The RCDD shall be present during construction and all cable testing and shall have:
      a. Knowledge of BICSI installation standards
      b. Knowledge of NEC standards
      c. Knowledge of ANSI/TIA standards
   3. Other Installers
   4. Products shall only be installed by qualified technicians certified by the product manufacturers.

G. Compliance with Laws, Ordinances, and Codes
   1. Comply in every way with the requirements of local laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. Anything in the plans or specifications that does not strictly comply with the above laws, ordinances, and rules must be referred to the attention of the Engineer for a decision before proceeding. No change in the plans or specifications shall be made without full consent, in writing, of the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling
   1. To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling. Protect equipment during transit, storage, and handling.

B. Storage
   1. The Contractor shall coordinate the secure storage of equipment and materials on-site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor’s expense.
   2. Do not store equipment where conditions fall outside manufacturer’s recommendations for environment.
   3. Do not install damaged equipment. Remove from site and replace damaged equipment with new equipment.
   4. If off-site storage of materials is necessary, this shall be at the Contractor’s expense.

1.07 COORDINATION

A. Installation Schedule
   1. The contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 10 days of contract award.

2. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.

B. Meeting Attendance and Schedule Adherence
   1. The Contractor must attend project related meetings and adhere to the schedule set by the project manager.

C. Final Inspection
   1. The contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment.
   2. Within five working days after the final inspection, the Contractor shall send final project documentation and warranty information to the Owner and Architect. The final project documentation shall include, but may not be limited to the following:
      a. As Built Drawings, with legible cable paths, in an AutoCAD format listed in this Section
      b. Warranty Paperwork
      c. A copy of the Final Inspection and Acceptance Sign-off Sheet

1.08 PROJECT CONDITIONS

A. Project Environmental Requirements
   1. Seismic Safety
      a. Provide mechanical and electrical support for all installed equipment as required by all applicable local building codes for this installation's earthquake risk hazard zone and as recommended by Telcordia Specification GR-63.
      b. Mount overhead devices with appropriate safety attachments as required.
      c. Provide shock and vibration isolation of equipment and fixtures as required.

B. Existing Conditions
   1. Verify all project site conditions applicable to the Work of this Section. Notify the Consulting Engineer in writing of any discrepancies, conflicts, or omissions prior to bid opening. Otherwise, correct these at no additional cost to the Owner.
   2. Continue to monitor the project site. If conditions develop requiring a need to vary from the Specifications or Drawings, notify the Owner immediately in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and on approval, proceed with the necessary changes without additional cost to the Owner.

C. Record Drawings
   1. Keep a complete set of all telecommunications drawings in the job site office for demonstration of actual installation work under this Section.
   2. Use this set of drawings for no other purpose.
   3. Where any material, equipment, or system components are installed differently than what is shown on the drawings, indicate differences clearly and neatly using ink or indelible pencil.
   4. Upon completion of the project, submit the record set of drawings.

1.09 USE OF THE SITE

A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.

B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.

C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on how and when to work in these areas.

D. Multiple times each day, each contractor shall remove all trash and debris from the site.

E. Before leaving the room each day:

1. The Contractor shall replace all ceiling tiles that they have remove.
2. The Contractor shall place all furniture and equipment that they have moved back into its original location.
3. The Contractor shall return any equipment that they have disconnected to working order.
4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.
5. It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.

1.10 CONTINUITY OF SERVICES

A. Take no action that will interfere with or interrupt the existing building services unless previous arrangements have been made with the Owner's representative. Arrange all work so as to minimize shutdown time.

B. The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the contractor shall give five (5) days' advance notice.

C. Should services be inadvertently interrupted:
   1. The Job Foreman shall immediately notify the Project Manager of any accidental disruption of services, the remedy, and how long it will take to restore services.
   2. The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner.

1.11 WARRANTY

A. The Contractor shall provide the following warranties for the system and components.
   1. Contractor Materials and Labor Warranty
   2. The Contractor shall provide system warranties, for a period specified in the contract documents, against faulty materials and defects in workmanship. The Contractor shall also honor any manufacturer warranties that exceed this period of time.
   3. Manufacturer Component Warranty
   4. All components of the telecommunications pathway systems shall be free from manufacturing defects in material or workmanship, under normal and proper usage, for a minimum of one (1) year.

B. The Manufacturer shall bear the burden to replace or repair any defective products during the warranty period at their cost, including labor and materials.

C. The warranty period shall begin at the date of the Owner's Acceptance of the Work. Evaluation of quality and workmanship shall be solely by the Owner or the Owner's representatives.

1.12 SUBMITTALS

A. Operation Manual
   1. The Contractor shall provide an Operations Manual. This manual and all related documentation shall be property of the owner and shall include the following:
   2. A Table of Contents
   3. Typed description of each pathway system, including key features and operational concepts (such as under floor basket, overhead basket, overhead cable duct)
   4. Small-scale plans showing the locations of all pathway systems

B. Maintenance Data Manual
   1. The Contractor shall provide an Operations Manual. This manual and all related documentation shall be property of the owner and shall include the following:
   2. A Table of Contents
   3. The company name, address, telephone number, and contact name for system service or maintenance
   4. A listing of all equipment and materials with names of manufacturers and model numbers or part numbers.
   5. Catalog data sheets displaying manufacturer's names, addresses, and telephone numbers

6. Product manufacturers' warranties that explicitly cover all materials and labor
7. Manufacturers' service manuals for all major equipment items

PART 2 PRODUCTS

2.01 GENERAL NOTES

A. In this section, certain products specified by manufacturer and part number to establish a level of quality, performance, and consistency. To substitute other products would defeat this effort to the Owner's detriment. If no manufacturer or part number is specified for a part, then that part is generic, and the Contractor shall submit for approval a part that provides the performance specified herein.

B. All products, including but not limited to non-continuous cable supports, wire welded basket, cable runway, and non-metallic cable ducting shall be manufactured by Panduit. Owner Furnished Equipment (OFE) and materials shall be appropriate for the intended use and shall be recognized as such by a Nationally Recognized Testing Laboratory (NRTL), such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA), or the American National Standards Institute (ANSI).

C. All products shall be new, of the latest version at time of bid, and brought to the job site in the original manufacturer's packaging. Electrical components shall bear the UL or ETL label, and this listing requirement shall apply to the entire assembly. Only systems and equipment that meet or exceed the level of quality and the capabilities stated in this document will be considered for acceptance. Used equipment and damaged material will be rejected.

D. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

E. Materials shall be listed and approved for the particular application and permitted by the Authority Having Jurisdiction (AHJ) for the application.

F. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.

G. All components will be approved by the Engineer and shall have the highest aesthetic value possible while providing the specified functionality. Hardware shall:
   1. Be in compliance with the Construction Documents
   2. Have fit and finish compatible with the existing surrounding structure
   3. Be unobtrusive
   4. Provide the required functionality

H. Fabricate custom-made equipment with careful consideration given to the aesthetic, technical, and functional aspects of equipment and its installation.

I. Provide products that are suitable for the intended use, for the environment in which they are to be installed, that meet regulatory requirements, and that comply with applicable electrical codes.

2.02 CONDUIT

A. Sizing of Conduit
   1. The conduit used shall:
   2. Be at least trade size 1
   3. Have capacity for 50% expansion
   4. Be large enough so that cables occupy no more than 40% of the internal area of each conduit

B. Conduit as Horizontal Raceway
   1. An appropriate quantity of minimum trade size 4 conduit shall be used as a horizontal raceway system for telecommunications cabling when:
   2. It is required by code
   3. Crossing over inaccessible ceiling spaces (E.G. hard lid ceiling)
   4. Special mechanical protection is required

C. Flexible Conduit
   1. The use of flexible metal conduit is not permitted. If flexible conduit is required, it must be pre-approved on a case-by-case basis and meet the following requirements.
   2. Each run shall be less than 6 m (20 feet) long.
   3. The conduit selected shall minimize cable abrasion during the installation of cables.

D. Conduit Length
   1. No section of conduit shall be longer than 30 m (100 feet) between pull points.

E. Bends
   1. No section of conduit shall contain more than two 90º bends, or equivalent, between pull points (such as outlet boxes, pull boxes, or distributor rooms). If there is a reverse (U shaped) bend in the section, a pull box shall be installed.
   2. For conduits with an internal diameter of 2 inches (50 mm) or less, the inside radius of a bend in conduit shall be at least 6 times the internal diameter.
   3. For conduits with an internal diameter of more than 2 inches (50 mm), the inside radius of a bend in conduit shall be at least 10 times the internal diameter.
   4. Bends in the conduit shall not contain any kinks or other discontinuities that may have a detrimental effect on the cable sheath during cable pulling operations.

F. Pull Tension
   1. The pull tension of the cable being installed shall not be exceeded. Some factors that determine pull tension of cable include:
      a. Conduit size
      b. Length of conduit
      c. Location and severity of bends
      d. Cable jacket material
      e. Cable weight
      f. Number of cables
      g. Conduit material
      h. Lubricants
      i. Direction of pull
      j. Firestopping
   2. Cable pulling tensions may be reduced by using lubricants. Use care in selecting a lubricant, taking into consideration compatibility with cable jacket composition, safety, lubricity, adherence, stability, and drying speed.

G. Pull Boxes
   1. Conduit fittings shall not be used in place of pull boxes.
   2. Pull boxes shall be readily accessible and shall not be placed in a fixed false ceiling space, unless immediately above a suitably-marked access panel.
   3. A pull box shall be placed in a conduit run where:
      a. The run is over 30 m (100 feet) long
      b. There are more than two 90º bends, or equivalent
      c. There is a reverse (U-shaped) bend in the run
   4. Pull boxes shall be placed in a straight section of conduit and shall not be used in lieu of a bend. The corresponding conduit ends should be aligned with each other.
   5. Where a pull box is required with conduits smaller than metric designator 35 (trade size 1¼), a four-square outlet box may be used.
   6. Where a pull box is used with conduits larger than metric designator 35 (trade size 1 ¼), it shall be sized as listed in the following table.

metric designator	*trade size*	*width mm (in)*	*length*	*depth*	*width increase for additional conduit*
27	1	102 mm (4 inches)	406 mm (16 inches)	76 mm (3 inches)	51 mm (2 inches)
35	1¼	152 mm (6 inches)	508 mm (20 inches)	76 mm (3 inches)	76 mm (3 inches)
41	1½	203 mm (8 inches)	686 mm (27 inches)	102 mm (4 inches)	102 mm (4 inches)
53	2	203 mm (8 inches)	914 mm (36 inches)	102 mm (4 inches)	127 mm (5 inches)
63	2½	254 mm (10 inches)	1067 mm (42 inches)	127 mm (5 inches)	152 mm (6 inches)
78	3	305 mm (12 inches)	1219 mm (48 inches)	127 mm (5 inches)	152 mm (6 inches)
91	3½	305 mm (1 inches 2)	1372 mm (54 inches)	152 mm (6 inches)	152 mm (6 inches)
103	4	381 mm (15 inches)	1524 mm (60 inches)	203 mm (8 inches)	203 mm (8 inches)

7. If the pull box is comprised of metallic components, it shall be bonded to ground in accordance with the Authority Having Jurisdiction (AHJ).

H. Pathway Termination

I. To prevent poured concrete from entering conduits protruding through the the distributor room floor during construction and to protect cabling and firestop materials from water and other liquid spills, such conduits shall be terminated 25 to 75 mm (1 to 3 inches) above the floor surface.

J. To prevent partial bend transitions through the wall and to ensure that the cable is at a height that may be fed to connecting hardware without interfering with equipment racks or back panels, conduits within the ceiling shall protrude into the room from 25 to 75 mm (1 to 3 inches), without a bend, and above the 2.4 m (8 foot) level.

2.03 NON-CONTINUOUS CABLE SUPPORTS

A. Non-continuous cable supports must:
1. Have a cable-bearing surface on the bottom that is at least equal to the full radius of the cable
2. Maintain complete horizontal and vertical bend radius control of 1 inch
3. Have 90° radius edges to prevent damage while installing cables
4. Be designed so that the mounting hardware is recessed to prevent cable damage
5. Have a removable and reusable hook and loop retainer to contain the cables within the hook
6. Be factory-assembled for direct attachment to walls, hanger rods, beam flanges, purlins, struts, floor posts, etc. as needed for various on-site conditions
7. Be manufactured from a non-conductive material suitable for use in air-handling spaces

B. To provide separate cabling compartments or where additional capacity is needed, multi-tiered non-continuous cable supports shall be used.

C. Shall support no more than the quantity of cables recommended by the manufacturer

2.04 FIBER RUNNER – NONMETALLIC CABLING DUCT

A. Nonmetallic cabling duct shall be used to segregate and route cables between the equipment racks and cabinets in the data center. The nonmetallic cabling duct system shall include, but is not limited to, straight sections of channel, covers, couplers, fittings, and brackets.

B. Nonmetallic Cabling Duct Materials

C. The channel and all nonmetallic system components shall be manufactured with UL-recognized materials that exhibit nonflammable self-extinguishing characteristics of UL94 (V 0).
   1. The base and cover shall be manufactured of a rigid PVC material.
   2. Molded fittings shall be manufactured of a rigid ABS material.
   3. Acceptable color is yellow.

D. Channel and Cover
   1. The nonmetallic cabling duct system channel and cover shall meet the following requirements:
   2. It shall have a two-piece design, with a base and cover.
   3. To retain and inhibit cover movement, it shall have an integral high-friction design.
   4. The 12 inch by 4 inch (305 mm x 100 mm), the 6 inch by 4 inch (150 mm 100 mm), and the 4 inch by 4 inch (100 mm x 100mm) covers shall snap on the base and shall hinge from one side.
   5. The 2 inch by 2 inch (51 mm x51 mm) covers shall snap on the base and hinge from both sides.

E. Couplers
   1. Couplers shall be used at each connection.
   2. Each fitting-to-fitting, channel-to-fitting, and channel-to-channel connection shall require a coupler.
   3. Couplers shall be supplied pre-assembled. They shall be ready to use they shall not require any bolts to fasten, nor shall any adjustments need to be made.
   4. The coupler shall be removable when needed.

F. Fittings
   1. A full complement of fittings must be available including, but not limited to, 45° and 90° flat, vertical, inside and outside elbows, horizontal and vertical tees, cross fittings, spillouts, reducers, end caps, and all other components required to make the system workable.
   2. Snap-on split covers shall be available for all directional fittings.
   3. The fittings shall be capable of maintaining a minimum cable bend radius of 2 inches (51 mm).
   4. All fitting bases and covers shall be supplied as separate components, except for the 2 inch by 2 inch (51 mm x 51 mm) size, where the fitting bases and covers are supplied together.

G. System Spillouts and Accessories
   1. Multiple spillout options shall be provided to accommodate the safe transition from horizontal to vertical runs into various equipment and rack configurations.
   2. The spillout options shall include, but are not limited to, channel, slotted channel, and corrugated loom tubing.

H. Mounting Brackets
   1. A full complement of mounting brackets must be available, including, but not limited to, new and existing threaded rod bracket kits, wall bracket kits, cabinet bracket kits, equipment rack kits, and all other components necessary to make the system workable.
   2. The mounting brackets shall be manufactured from commercial grade cold-rolled steel with zinc chromate, e-coating, or painted black powder coat finish.

3. The channel shall be attached to the brackets by securing the bracket slide clamps to the rail on the bottom of the channel base.

2.05 WIRE TRAY – OVERHEAD CABLE TRAY

A. NFPA 70

B. Cable trays and accessories shall be as defined in NFPA 70 and shall be marked for intended location, application, and grounding.

C. Source Limitations

D. Obtain cable trays and components in compliance with the requirements outlined in in this specification.

E. Sizes and Configurations

F. Provide cable trays and accessories of the types, materials, sizes, and configurations specified by the cable tray drawings.

G. Structural Performance

H. The cable tray must be capable of supporting a uniformly-distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
   1. Concentrated Load: A load applied at midpoint of span and centerline of tray.
   2. Load and Safety Factors: Applicable to both side rails and rung capacities.

I. Configuration
   1. The cable tray shall be formed of a wire mesh pattern with intersecting wires welded together. The mesh sections must have at least one bottom longitudinal wire along entire length of the section.
   2. To minimize cutting on straight sections and eliminate cutting at intersections, straight sections of the cable tray shall be furnished without integral sidewalls.
   3. To retain cables within the cable tray system, optional snap-on sidewalls shall be installed where needed.
   4. To accommodate future cabling requirements without having to replace the cable tray, the optional snap-on sidewalls must be removable, so that they can be replaced with larger sidewalls.

J. Materials

K. The cable tray shall have high-strength steel longitudinal wires with no bends.

L. Safety Provisions

M. To protect the cables from damage and installers from injury, the wire ends along the wire-mesh pathway shall be rounded during manufacturing.

N. Sizes
   1. Straight sections of the cable tray shall be furnished in standard 10-foot lengths.
   2. Standard size:
      a. 24 inches wide x 6 inches high

O. Splice Connectors
   1. Splice connectors shall allow for two sections of the cable tray to be quickly joined.
   2. To ensure electrical continuity throughout the cable tray system, the cable tray shall have an integrated screw feature that mechanically bonds continuous pathway sections.
   3. Neither splices in the support span nor intersections shall diminish the rated loading capacity of the cable tray.

P. Materials and Finishes

Q. The cable tray shall:
   1. Have straight sections and fittings that are constructed of steel that complies with the minimum mechanical properties of ASTM A 1008/A 1008M
   2. Have steel splice connectors that comply with SAE/AISI 1095

R. Cable Tray Accessories
   1. The cable tray system shall have tees, crosses, risers, elbows, and other fittings of the same materials and with the same finishes as the cable tray.
   2. The cable tray supports and connectors, including bonding jumpers, shall be as recommended by the cable tray manufacturer.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall perform the installation in accordance with the following guidelines.

B. Provide any necessary screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. necessary to facilitate the installation of the communications pathway system.

C. Furnish any special installation equipment or tools necessary to properly complete the installation.

D. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to bring the installation back into alignment with the guidelines and to correct any and all damage to the cables caused by the installer during the implementation.

E. Provide fire blocking at all fire-rated ceiling, wall, and floor penetrations.

F. Plug conduits where cabling has been installed in the main equipment room, backbone, and other cable entrance locations with re-enterable duct seal of flame-retardant putty.

G. Provide bushings on all conduit ends.

H. All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify performance characteristics that meet ANSI/TIA 568 Standards, provide all Original Equipment Manufacturer (OEM) documentation to the Owner.

I. All techniques and fixtures used in the installation must allow for easy maintenance of, and ready access to, all components for test measurements.

J. No self-tapping screws shall be used.

K. All materials used in the installation shall be resistant to fungus growth and moisture deterioration.

L. To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar metals with an inert dielectric material.

M. All empty conduit shall include a non-corrosive pull-rope.

N. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

O. Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer. The Contractor shall input the cabling data into the cable management software.

3.02 NON-CONTINUOUS CABLE SUPPORTS

A. Non-continuous cable supports shall be used to support horizontal cables from the point of their exit from the main pathway (wire basket) to the point of termination.

B. Follow the manufacturer’s recommendations for allowable fill capacity for each size of non-continuous cable support.

C. Installation and configuration of non-continuous cable supports shall conform to the requirements of the ANSI/EIA/TIA Standards 568 and 569, NFPA 70 (National Electrical Code), and applicable local codes.

D. Non-continuous cable supports shall be placed straight, following building lines on 48 inch to 60 inch (1200 mm to 1500 mm) centers.

E. Non-continuous cable supports shall be attached to walls, purlins, beams, threaded-rod, or other components in strict compliance with all manufacturer Instructions and as directed by the Authority Having Jurisdiction (AHJ).

3.03 FIBER RUNNER – NON-METALLIC CABLING DUCT

A. Coordinate the installation of the fiber optic cable pathway with all other work as required to properly interface installation of this pathway with cabinets, racks, etc.

B. In spaces through which fiber optic cable pathway is run, provide sufficient space to install and maintain cables.

C. Cut all fiber optic cable pathway using a miter box and saw. For clean, burr-free cuts, cut larger quantities with a plastic cutting saw blade. A carbide 80T or 100T blade, .090 thick, with a 0.125 inch kerf is recommended.

D. Install the fiber optic cable pathway in accordance with recognized industry practices per UL 2024A, to ensure that the system complies with the requirements of the UL / ULC standards that pertain to Optical Fiber Cable Routing Assemblies for Riser.

3.04 BASKET TRAY

A. Install cable tray as indicated, in accordance with recognized industry practices (NEMA VE-2 2000), to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA “Standards of Installation” pertaining to general electrical installation practices.

B. Coordinate the installation of cable tray with mechanical, electrical, and plumbing work as required to properly interface cable tray installation with other work.

C. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, splice connectors, elbows, tees, crosses, cable dropouts, adapters, and bonding.

D. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

E. Remove burrs and sharp edges from cable trays.

F. Fasten cable tray supports to building structure.

G. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

H. Construct supports from channel members, threaded rods, and other appurtenances furnished by the cable tray manufacturer. Arrange supports in trapeze or wall-bracket form, as required by the application.

I. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

J. Support wire-mesh cable trays with trapeze hangers and wall brackets.

K. Support trapeze hangers for wire-mesh trays with 1/2-inch (13 mm) diameter rods.

L. Make changes in direction and elevation using the manufacturer’s recommended fittings.

M. Make cable tray connections using the manufacturer’s recommended fittings.

N. Seal penetrations through fire and smoke barriers, in compliance with the requirements set forth by the Authority Having Jurisdiction (AHJ).

O. Install cable trays with enough workspace to permit access for installing cables.

P. After installing the cable tray, install warning signs in visible locations on or near cable trays.

Q. Test wire basket support systems to ensure the electrical continuity of bonding and grounding connections and to demonstrate compliance with the specified maximum grounding resistance. For testing and test methods, see NFPA 70B, Chapter 18.

3.05 TELECOMMUNICATIONS PATHWAY GROUNDING

A. Ground all metallic pathways according to NFPA 70, and provide additional grounding as specified In TIA 607 C.

B. Bond communications cable pathways together with splice connectors.

C. Bond control conductor pathways with splice connectors.

D. When using splice connectors, the Contractor shall ensure electrical continuity between pathway sections by tightening the integrated thread cutting screw until it pierces the paint of the adjacent pathway sections to create a completely bonded connection.

E. Have a tradesperson licensed by the Authority Having Jurisdiction (AHJ) bond all pathways by means of an appropriate “C” type tap, using a minimum #1 AWG tap conductor, to the electrical service earth at the nearest panel board.

3.06 CABLE INSTALLATION

A. Install cables only after each cable tray run has been completed and inspected.

B. Fasten and support cables that pass from one pathway to another or drop from cable trays to equipment enclosures. Fasten cables to the pathway at the point of exit, and support cables independent from the enclosure. The length of the cable between pathways or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

3.07 FIELD QUALITY CONTROL

A. Perform the following tests and inspections.
   1. After installing pathways and after electrical circuitry has been energized, survey for compliance with requirements.
   2. Visually inspect cable for damage. Correct sharp corners, protuberances in pathways, vibrations, and thermal expansion and contraction conditions that may cause damage.
   3. Verify that the number, size, and voltage of cables in the pathways do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate pathways.
   4. Verify that no items such as pipes, hangers, or other equipment intrude into the pathway.
   5. Remove all dust deposits, industrial process materials, trash, and anything else that might block tray ventilation.
   6. Visually inspect each pathway joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re torque areas any areas that appear to have issues.
   7. Ensure that all bonding screws have been secured on all splice connectors.
   8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. If any are found, replace them with the specified hardware.
   9. Perform visual and mechanical checks of pathway grounding. Verify that all takeoff raceways are bonded to cable trays. Test the entire pathway system for continuity. The maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

C. During construction, to protect exposed cables in open trays from falling objects or debris, install temporary protection constructed of wood or metal and keep this protection in place until there is no longer risk of damage.

END OF SECTION 27 0528

SECTION 27 0553

IDENTIFICATION FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. What This Section Includes

B. This Section (27 05 53) includes the specifications for:
   1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on drawings
   2. The specifications for the incorporation of Owner Furnished Equipment (OFE)
   3. The documentation and instruction for completing the Identification for Communication Systems

C. Related Drawings
   1. T-Series drawings follow the specifications in this Section.
   2. Electrical drawings specify the electrical requirements.
   3. Interior Design drawings specify interior finishes, spatial relationships between items, and specific mounting height.

D. What the Contractor Shall Provide and Install

E. Although such work is not specifically mentioned herein or on the drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or required for a sound, secure, and complete installation, without claim for additional payment.

F. Errors or Omissions in Drawings or Documentation
   1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting bid.
   2. Should conflict occur in or between drawings and specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained a written decision (addendum), before submission of the bid, as to which method or materials will be required.

G. Dimensions

H. Dimensions indicated are limiting dimensions.
   1. Do not use equipment exceeding dimensions indicated.
   2. Do not use equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.

1.02 REFERENCES

A. Requirements, Codes, and Standards

B. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with latest revision of the NFPA-70 (National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJ), and the following standards, including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) that may have been released at the time of bid, including:
   1. TIA/EIA-606 – Administration Standard for Commercial Telecommunications Infrastructure

C. BICSI® Publications

D. Install cabling in accordance with the most recent edition of BICSI® publications:
   1. BICSI – Telecommunications Distribution Methods Manual, 12th Edition
   2. BICSI – Information Technology Systems Installation Manual, 6th Edition

3. BICSI – Outside Plant Design Reference Manual, 5th Edition

E. Applicability of Codes, Rules, and Regulations
   1. Federal, state, and local codes, rules, regulations, and ordinances governing the work are as fully part of the specifications as if herein repeated or hereto attached.
   2. If the contractor should note items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's representative in writing.
   3. Where the requirements of other sections of the specifications are more stringent than the applicable codes, rules, regulations, and ordinances, the specifications shall apply.

F. Definitions
   1. The following are the definitions of the terms used in this Section:
   2. AWG – American Wire Gauge – The standardized system for gauging the diameter of round, solid, non-ferrous, electrically-conducting wire.
   3. BBC – Bonding Backbone Conductor – A telecommunication bonding connection which interconnects telecommunications bonding backbones. Formerly known as the grounding equalizer.
   4. HC – Horizontal Cross-connect – A group of connectors, such as patch panels or punch-down blocks, that allow horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers.
   5. HDA – Horizontal Distribution Area – A space in a computer room where a Horizontal Cross-connect (HC) is located and which may include LAN switches, Storage Area Network (SAN) switches, and Keyboard/Video/Mouse (KVM) switches for the end equipment located in the equipment distribution areas.
   6. IC – Intermediate Cross-connect – A facility enabling the termination of different levels of backbone cabling and interconnection between them or equipment.
   7. MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling, or equipment
   8. MDA – Main Distribution Area – The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC).
   9. PBB – Primary Bonding Busbar – A busbar placed in a convenient and accessible location and bonded, by means of the Telecommunications Bonding Conductor (TBC), to the buildings service equipment (power) ground. Formerly known as the Telecommunications Main Grounding Busbar (TMGB).
   10. RBB – Rack Bonding Busbar – A busbar within a cabinet, frame, or rack.
   11. RBC – Rack Bonding Conductor – A bonding conductor from the rack or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).
   12. SBB – Secondary Bonding Busbar – A common point of connection for telecommunications system and equipment bonding to ground, located in the distributor room. Formerly known as the Telecommunications Grounding Busbar (TGB).
   13. TBB – Telecommunications Bonding Backbone – The conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).
   14. TBC – Telecommunications Bonding Conductor – A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.
   15. TEBC – Telecommunications Equipment Bonding Conductor – A conductor that connects the primary
   16. TO – Telecommunications Outlet – A connecting device, located in a work area, at which the horizontal cabling terminates.
   17. UBC – Unit Bonding Conductor – A bonding conductor from equipment or a patch panel to a rack bonding conductor or a rack bonding busbar.

1.03 SYSTEM DESCRIPTION

A. The Contractor will provide and install identification labeling for the project's voice and data communications systems, including all components from the communications outlet to the serving telecommunications room and between telecommunications spaces.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handling
   1. To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling.

B. Storage
   1. The Contractor shall coordinate secure storage of equipment and materials onsite or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense.
   2. Do not store equipment where conditions fall outside manufacturer's recommendations for environmental conditions.
   3. Do not install damaged equipment. Remove damaged equipment from the site, and replace it with new equipment.
   4. If off-site storage of materials is necessary, this shall be at the Contractor's expense.

1.05 COORDINATION

A. Installation Schedule
   1. The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 10 days of contract award.
   2. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.

B. Meeting Attendance and Schedule Adherence
   1. The Contractor must attend project-related meetings and adhere to the schedule set by the Project Manager.

C. Final Inspection
   1. The Contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment.
   2. Within five working days after the final inspection, the Contractor shall send final project documentation and warranty information to the Owner and Engineer. The final project documentation shall include, but may not be limited to:
      a. As-Built Drawings, in AutoCAD format, with legible outlet address and cable paths
      b. Outlet location spreadsheets
      c. Warranty paperwork
      d. A copy of the Final Inspection and Acceptance Signoff Sheet

1.06 PROJECT CONDITIONS

A. Project Environmental Requirements
   1. Optical Fiber Cable Safety
   2. The following warnings shall be posted on the job site:
      a. WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED OR LASER SOURCE OR INTO THE END OF A CABLE FIBER CONNECTED TO ONE OR THESE SOURCES.
      b. CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE VISIBLE, YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR WARNING LABELS ON SOURCE DEVICES.
      c. Observe all warning signs on equipment and all written safety precautions in instruction and technical manuals.

d. Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin.

B. Existing Conditions
   1. Verify that all conditions on the project site applicable to the Work specified in this Section are as documented and are appropriate for the Work. Prior to bid opening, notify the Consulting Engineer in writing of any discrepancies, conflicts, or omissions. Otherwise, correct these at no additional cost to the Owner.
   2. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and upon approval, proceed with the necessary changes without additional cost to the Owner.

C. Record Drawings:
   1. Keep a complete set of all telecommunications drawings in the job site office for demonstration of actual installation of work under this Section.
   2. Use this set of drawings for no other purpose.
   3. When any material, equipment, or system components are installed differently than what is shown on the drawings, indicate differences clearly and neatly using ink or indelible pencil.
   4. Upon completion of the project, submit record set of drawings.

1.07 USE OF THE SITE

A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.

B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.

C. Request a hazardous materials worksheet that identifies potential-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on how and when to work in these areas.

D. Multiple times each day, each contractor shall remove all trash and debris from the site.

E. Before leaving the site each day:
   1. Contractor shall replace all ceiling tiles that they have removed.
   2. The Contractor shall place all furniture and equipment that they have moved back into its original location.
   3. The Contractor shall return any equipment that they have disconnected to working order.
   4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.
   5. It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.

1.08 CONTINUITY OF SERVICES

A. Take no action that will interfere with or interrupt the existing building services unless previous arrangements have been made with the Owner's representative. Arrange all work to minimize shutdown time.

B. The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the contractor shall give five (5) days' advance notice.

C. Should building services be inadvertently interrupted:
   1. The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services.
   2. The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL NOTES

A. In this section, certain products are specified by manufacturer and part number to establish a level of quality, performance, and consistency. To substitute other products would defeat this effort to the Owner's detriment. If no manufacturer or part number is specified for a part, then that part is generic, and the Contractor shall submit for approval a part that provides the performance specified herein.

B. All products specified in this section, shall be manufactured by Panduit or Owner approved alternate. Owner Furnished Equipment (OFE) and materials shall be appropriate for the intended use and shall be recognized as such by a Nationally Recognized Testing Laboratory (NRTL), such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA), or the American National Standards Institute (ANSI).

C. All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Electrical components shall bear the UL or ETL label, and this listing requirement shall apply to the entire assembly. Only systems and equipment that meet or exceed the level of quality and the capabilities stated within this document will be considered for acceptance. Used equipment or damaged material will be rejected.

D. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

E. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.

F. All components will be approved by the Engineer and shall have the highest aesthetic value possible while providing the specified functionality. Hardware shall:
   1. Be in compliance with the Construction Documents
   2. Have fit and finish compatible with the existing surrounding structure
   3. Be unobtrusive
   4. Provide the required functionality

G. Provide products that are suitable for the intended use, for the environment in which they are to be installed, that meet regulatory requirements, and that comply with applicable electrical codes.

2.02 IDENTIFICATION

A. Labels
   1. Label Construction
   2. Labels shall be white, manufactured of resilient and flexible vinyl or polyester, die-cut, and have adhesive backing for permanent attachment.
   3. Labels for Data Cables
   4. Labels for data cables shall be:
      a. Self-laminating
      b. Rotatable/repositionable
      c. Of appropriate size to completely encircle the cable and completely overlay the identification tag area
   5. Placement of Data Cable Labels
   6. Labels shall be placed within view at the termination points, within 3 inches (75 mm) of each end of each:
      a. Backbone cable
      b. Horizontal cable
      c. Bonding conductor
   7. Labels for Data Cable Bundles
      a. Cable bundles shall be identified with non-adhesive thermal-transfer-printable marker plates.

b. Marker plates shall be attached to cable bundles with nylon cable ties or hook and loop ties.
c. Marker plates shall offer legends and shall meet the requirements of MIL-STD-202G, Notice 12 Method 215J (Thermal Transfer Printable Marker Plates).

8. Labels for Cabinets and Equipment
   a. Cabinets and equipment shall be identified with thermal-transfer-printed, die-cut, microcellular foam labels with a polyester printable surface and high-tack adhesive.
   b. Each outlet, patch panel, and wiring block shall be identified by a label installed on or in the space provided on the device.
9. Label Sizes for Outlets and Termination Hardware
10. Labels for outlets and termination hardware shall be at least 1-1/4 inches wide and 3/8 inch high.
11. Label Sizes for Other Equipment
12. Labels for the following shall be at least 4 inches wide and 1 inch high:
    a. Riser cables
    b. Network equipment
    c. Equipment cabinets and racks
    d. Bonding busbars
    e. Consolidation point enclosures
    f. Active hardware and equipment

B. Warning Tags
1. At each location where the fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall:
   a. Be yellow or orange
   b. Bear the warning, “CAUTION FIBER OPTIC CABLE”
   c. Have this text in permanent, black, block characters at least 5 mm high
2. A warning tag shall be permanently affixed to each exposed cable or bundle of cables at intervals of not less than 1.5 m.
3. Any section of exposed cable less than 1.5 m long shall have at least one warning tag affixed to it.

C. Printing of Labels
1. Printing shall be machine-generated in permanent ink that contrasts the background color.
2. All characters shall be block style.
3. The text shall fill the area of the printable field.

PART 3 EXECUTION

3.01 GENERAL

A. Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer, and the Contractor shall input the cabling data into the cable management software.

B. Provide any necessary screws, anchors, clamps, tie wraps, support hardware, etc. necessary to facilitate the installation of the identification communication system.

C. Furnish any special installation equipment or tools necessary to properly complete the installation.

D. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to bring the installation back into alignment with the guidelines and to correct any and all damage to the cables by the installer during the implementation.

E. All techniques and fixtures used in the installation must allow for easy maintenance of, and ready access to, all components for test measurements.

F. No self-tapping screws shall be used.

G. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass.

H. All materials used in installation shall be resistant to fungus growth and moisture deterioration.

I. To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar metals with an inert dielectric material.

3.02 SYSTEM ADMINISTRATION

A. All components of the installed system shall be uniquely identified by location, function, unit, and sub-unit.

B. Each location shall be identified by a unique alphanumeric identifier.

C. Each equipment enclosure in the building shall be assigned a unique alphanumeric identifier.

D. Each adapter module installed in each distribution or interconnect enclosure shall be identified by an alphanumeric identifier.

E. All conduits, trays, and pathways shall be identified by a unique alphanumeric identifier.

F. Optical fiber cables shall be identified by a textual label, which indicates its type, strand count, point of origin, and termination.

G. Supply a Cable Identification Matrix.

H. Supply all records in compliance with ANSI/TIA-606.

I. Provide a cable schedule, hard copy and in electronic spreadsheet format, for administration of the Structured Cabling System described herein.

3.03 IDENTIFICATION

A. Prior to the installation or termination of cabling, confirm all specific labeling requirements with the Owner.

B. Cables
   1. Mark backbone cables at each endpoint and at all intermediate pull points, access points, and junction boxes. Labels shall indicate the origination and destination identifier, the sheath identifier, and the strand or pair range.
   2. Horizontal cables shall be marked at each end, on the sheath indicating the telecommunications room, patch panel and panel port to which the cable is wired.
   3. Faceplates, Patch Panels, and Wiring Blocks
   4. Mark Fiber Distribution Enclosures (FDEs) with adhesive labels that indicate the range of circuits installed within. Label each port with the origination and destination grid identifier and the individual strand ID.
   5. Label patch panels alphabetically, beginning at the top. Individual ports shall come from the factory labeled with a number designation.
   6. Label each faceplate to indicate, for each cable that it houses, the Telecommunications Room, patch panel, and panel port to which the cable is wired.
   7. Fit each cable with a self-laminating label, bearing the appropriate cable identifier that surrounds the outermost jacket. Place the label at each end of the cable, within 3 inches (75 mm) of the end of the sheath.
   8. Fit each equipment enclosure with a self-adhesive label bearing its respective identifier, affixed to the top center of the front and rear doors.
   9. Fit each FDE with a self-adhesive label, bear its respective identifier in block characters, affixed at the top center of the front and rear faces.
   10. Fit each adapter inside enclosures with a label bearing its identifier, affixed directly adjacent to its shortest side. Rotate characters so that their orientation is kept left to right, top to bottom.
   11. Label conduits and pathways within 0.5 m (18 inches) of each end, where exposed and accessible. It is recommended that additional labeling be provided every 3 m (10 feet) of exposed length.

END OF SECTION 27 0553

SECTION 27 1100

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. This Section (27 11 00) includes the specifications for:
   1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on drawings
   2. The specifications for the incorporation of Owner Furnished Equipment (OFE)
   3. The testing, documentation, and instructions for completing the Communications Equipment Room.
   4. Products supplied but not installed under this section, including loose equipment specified herein which is to be turned over to the owner at the completion of this project.

B. Owner Furnished Equipment (OFE)

C. Certain equipment may be identified as Owner Furnished Equipment (OFE). This OFE may presently be part of the Owner's system, or may be provided by the Owner, and will either be delivered to the Contractor's off-site construction facility, be delivered to the Contractor's on-site secured storage area, or be installed on site by others, as appropriate, for incorporation into the system.
   1. Clean and inspect all OFE.
   2. Notify the Owner in writing of damage, defects, and the extent of any repair or adjustment required for the OFE to meet the original specification.
   3. Service OFE only as directed by the Owner under the arrangements of a separate contract, and incorporate repaired or adjusted OFE into the system as if provided new, except for warranty coverage.

D. Related Drawings
   1. T-Series drawings follow the specifications in this section.
   2. Electrical drawings specify the electrical requirements.
   3. Interior Design drawings specify the interior finishes, spatial relationships between items, and mounting heights.

E. What the Contractor Shall Provide and Install
   1. Although such work is not specifically mentioned herein or on the drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure and complete installation, without claim for additional payment.
   2. The Contractor shall provide system testing and demonstration, system documentation and instruction of Owner personnel without claim for additional payment.

F. Errors or Omissions in Drawings or Documentation
   1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.
   2. Should conflict occur in or between drawings and specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and a obtained written decision (addendum), before submission of the bid, as to which method or materials will be required.

G. Dimensions

H. Dimensions indicated are limiting dimensions.
   1. Do not use equipment exceeding dimensions indicated.
   2. Do not use equipment or arrangements that reduce the required clearances or exceed the specified maximum dimensions.

1.02 REFERENCES

A. Requirements, Codes, and Standards

B. Design, manufacture, test, and install telecommunications cabling networks per the manufacturer's requirements and in accordance with latest revision of the NFPA-70 (National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJs), and the following standards including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) released at the time of bid:
   1. ANSI/NECA/BICSI 607 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
   2. ANSI/BICSI 002 Data Center Design and Implementation Best Practices
   3. ANSI/TIA 568 Series – Telecommunications Cabling Standards
   4. TIA-569 -– Commercial Building Standard for Telecommunications Pathways and Spaces
   5. TIA-606 – Administration Standard for Commercial Telecommunications Infrastructure
   6. TIA-607 – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
   7. TIA-526 Series – Standard Test Procedures for Fiber Optic Systems
   8. NECA/FOA 301– Installing and Testing Fiber Optic Cables
   9. TIA-942 – Telecommunications Infrastructure Standard for Data Centers

C. BICSI® Publications

D. Install cabling in accordance with the most recent edition of the following BICSI® Publications:
   1. BICSI – Telecommunications Distribution Methods Manual
   2. BICSI – Information Technology Systems Installation Manual
   3. BICSI – Outside Plant Design Reference Manual

E. Applicability of Codes, Rules, and Regulations
   1. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached.
   2. If the Contractor notes items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's representative in writing.
   3. Where the requirements of other Sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

F. Manufacturers' Recommendations

G. To maintain the applications warranties, install all cabling and termination devices using the manufacturers' recommended installation practices.

H. Definitions
   1. AWG – American Wire Gauge – The standardized wire gauge system for the diameter of round, solid, nonferrous, electrically-conducting wire.
   2. BBC – Bonding Backbone Conductor – A telecommunication bonding connection which interconnects telecommunications bonding backbones. Formerly known as the grounding equalizer.
   3. BN – Bonding Network – A set of interconnected conductive structures that provides a low impedance path for the associated telecommunications infrastructure.
   4. CP – Consolidation Point – A connection facility within Cabling Subsystem 1 for interconnection of cables extending from building pathways to the equipment outlet.
   5. EDA – Equipment Distribution Area – A space allocated for end equipment, including computer systems and telecommunications equipment.
   6. EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless that includes the entrance point of the building and continues to the entrance room or space. Also known as an MPOE (Minimum Point of Entry).
   7. ER – Equipment Room – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, considered

distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment. Also known as Data Center.

8. ESD – Electro Static Discharge – The sudden flow of electricity between two electrically-charged objects caused by contact, an electrical short, or dielectric breakdown.
9. HC – Horizontal Cross-connect – A group of connectors, such as patch panels or punch-down blocks, that allow horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers.
10. HDA – Horizontal Distribution Area – A space in a computer room where a Horizontal Cross-connect (HC) is located, and which may include LAN switches, Storage Area Network (SAN) switches, and Keyboard/Video/Mouse (KVM) switches for the end equipment located in the Equipment Distribution Areas (EDAs).
11. IC – Intermediate Cross-connect – A facility enabling the termination of different levels of backbone cabling and interconnection between them or equipment.
12. MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling, or equipment.
13. MDA – Main Distribution Area –The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC).
14. PBB – Primary Bonding Busbar – A busbar placed in a convenient and accessible location and bonded, by means of the Telecommunications Bonding Conductor (TBC), to the building's service equipment (power) ground. Formerly known as the Telecommunications Main Grounding Busbar (TMGB).
15. RBB – Rack Bonding Busbar – A busbar within a cabinet, frame, or rack.
16. RBC – Rack Bonding Conductor – A bonding conductor from the rack or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).
17. RU – Rack Unit A unit of measure, compliant with EIA 310, used to describe the height of equipment intended for mounting on equipment rails. One RU is 1.75 inches (44.45 mm) high.
18. SBB – Secondary Bonding Busbar – A common point of connection for telecommunications system and equipment bonding to ground, located in the distributor room. Formerly known as the Telecommunications Grounding Busbar (TGB).
19. TBB – Telecommunications Bonding Backbone – The conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).
20. TBC – Telecommunications Bonding Conductor – A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.
21. TEBC – Telecommunications Equipment Bonding Conductor – A conductor that connects the Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) to equipment racks or cabinets.
22. TO – Telecommunications Outlet – A connecting device, located in a work area, at which the horizontal cabling terminates.
23. TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. It is the recognized location of the cross-connect between the backbone and horizontal facilities. Also known as an IDF (Intermediate Distribution Frame).
24. UBC – Unit Bonding Conductor – A bonding conductor from equipment or a patch panel to a Rack Bonding Conductor (RBB) or a Rack Bonding Busbar (RBB).
25. ZDA – Zone Distribution Area – A space where a zone outlet or consolidation point is located, between the horizontal and equipment distribution areas, that allows frequent reconfiguration and flexibility.

1.03 SYSTEM DESCRIPTION

A. The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to

the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components as identified below.

B. Backbone Cable
   1. Vertical and horizontal backbone cabling will consist of hybrid optical fiber cable, installed from each TR to the ER.
   2. Provide 4RU fiber distribution enclosures at each end. Terminate with field-installable connectors or fusion splicing of factory cable assemblies and modular connector panels.
   3. For UTP backbone, provide IDC-type patch panels at each end, sized for the number of twisted pair cable assemblies to be installed. Terminate per manufacturer instructions.
   4. For coaxial cable, provide compression F-type connectors at each end. Terminate at the device end on a coupler attached to a faceplate. At the ER/TR terminate to passive devices as required to extend signal from the amplifier to the television set.

C. Typical Equipment Room (ER)

D. A typical ER will consist of the following equipment:
   1. Open 84-inch high 4-post enclosures with vertical and horizontal wire management
   2. 24-port or 48-port patch panels for termination of the horizontal cables served from this room
   3. Fiber Distribution Enclosures (FDEs)
   4. Rack-mounted Power Outlet Units (POUs)
   5. A grounding and bonding system connected to the building's main grounding electrode system
   6. A cable runway system, installed above the racks in the ER, to support and manage the cabling that runs from the racks to the equipment in the space, which shall be fitted with the proper termination and entrance equipment, such as waterfalls, support components, and bonding equipment

E. Typical Telecommunications Room (TR)

F. A typical TR will consist of the following equipment:
   1. Three (3) 96-inch floor-mounted 4-post open racks, which shall have horizontal and vertical cable management and horizontal stabilization, which may be provided by the cable runway from the rack to the wall and supports fabricated by the Contractor if required
   2. Category-6A rated termination hardware supporting all horizontal and UTP backbone cabling
   3. Rack-mounted FDEs for termination and interconnection of the optical fiber backbone
   4. A rack-mounted POU
   5. Fire-resistant, AC grade, 8' x 4' x ¾" thick, plywood installed on at least one (1) wall on which to install wall-mounted equipment
   6. A grounding and bonding system connected to the building's main grounding electrode system
   7. A cable runway system installed above the racks to support and manage the cabling that runs from the racks to equipment in the space, which shall be fitted with the proper termination and entrance equipment such as waterfalls, support, and bonding equipment

G. Pathways and Raceways
   1. Pathways and raceways are the support system for the infrastructure. All pathways and raceways shall conform to the latest edition of ANSI/TIA-569 Commercial Building Standard for Pathways and Spaces
   2. All horizontal and backbone cable shall be properly supported every 48 inches to 60 inches.
   3. Infrastructure support systems include, but not be limited to the following:
      a. Properly-supported cable runway
      b. Properly-supported conduits
      c. Non-continuous cable supports, which shall be spaced no more than 60 inches apart

d. Fiber raceway systems

H. Using a Combination of Cable Supports

I. The preferred method for providing pathways is to use a combination of cable tray and non-continuous cable supports.
   1. Cable trays shall be used for main horizontal cable pathways on all levels from the ER and TR locations
   2. Cable trays shall be installed in the main corridors
   3. Where practical, use independently-supported non-continuous cable supports in lieu of the cable tray system
   4. All backbone cable shall also follow these cable tray pathways
   5. Horizontal UTP and auxiliary system cables shall be combed and independently bundled. Bundle ties shall be easily removed for the addition or removal of cables
   6. To allow for future maintenance and access, the primary cable routes shall be located over corridors to the extent practical
   7. To protect cable from damage and to provide a suitable aesthetic appearance, in areas where the cable may be exposed, such as in open-ceiling rooms, conduit or surface raceway must be used instead of non-continuous cable supports.

1.04 SUBMITTALS

A. Engineer's Review
   1. The Engineer's review of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the contract documents.
   2. With the shop drawings, the Contractor shall include an index sheet detailing all deviations from the contract documents, and will be held responsible for all deviations unless the Contractor has received written approval from the Engineer for the specific deviation, separate from general shop drawing approval.
   3. The Engineer's review shall not relieve the Contractor from responsibility for errors or omissions in the contractor shop drawings or samples.

B. General Component Data

C. For all products covered under this Section, the Contractor shall submit the following data for each component covered under this Section:
   1. A Specification Section reference
   2. The manufacturer's name
   3. The manufacturer's model and part numbers

D. Racks

E. In addition to the general requirements above, the Contractor shall submit the following additional data:
   1. Rack specifications, including material, dimensions, color, accessories, and mountings
   2. Rack Elevation Drawings of equipment

F. Backboards

G. In addition to the general requirements above, the Contractor shall submit the following additional data:
   1. Data on backboard thickness and fire rating
   2. Data on backboard construction and dimensions

H. Connectors

I. In addition to the general requirements above, the Contractor shall submit the following additional data:
   1. Connector specifications

J. Splicing and Terminations

K. In addition to the general requirements above, the Contractor shall submit data on splicing and terminating tools, materials, and method

L. Testing

M. In addition to the general requirements above, the Contractor shall submit the following additional data:
   1. The equipment serial number and calibration certificate
   2. A graphic diagram documenting the proposed test procedure, including all connectors, the light source (as applicable,) the origin, and the destination of each cable tested

1.05 QUALITY ASSURANCE

A. Standards for Materials and Equipment
   1. The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.
   2. The Contractor shall provide all electronic equipment with the UL label when applicable.

B. Installer Qualifications
   1. Registered Communications Distribution Designer (RCDD)
   2. The Contractor must have at least one (1) Registered Communications Distribution Designer (RCDD) as recognized by Building Industry Consulting Service International (BICSI). The RCDD must be a full-time employee of the Contractor, and shall be responsible for the compliance of the work with the referenced standards and guidelines. At the time of bid, the RCDD shall provide a professional resume and proof of current registration to the Engineer for approval. The RCDD shall be present during construction and all cable testing and shall have:
      a. Knowledge of BICSI installation standards
      b. Knowledge of NEC standards
      c. Knowledge of ANSI/TIA standards
      d. Five (5) years of experience in the installation of optical fiber cables, including splicing, terminating, and testing, including single and multimode
      e. Three (3) years of experience in the installation of Category 6A Unshielded Twisted Pair (UTP) copper cables for structured cabling systems, including splicing, terminating, and testing, including complete verification of compliance with ANSI/TIA cable standards
      f. Certification by the manufacturer

C. Other Installers
   1. Products shall only be installed by qualified technicians certified by the manufacturer

D. Compliance with Laws, Ordinances, and Codes
   1. As applicable, all electronic equipment provided shall have the UL label
   2. Comply in every way with the requirements of local laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. Anything in the plans or specifications that does not strictly comply with the above laws, ordinances, and rules must be referred to the attention of the Engineer for a decision before proceeding. No change in the plans or specifications shall be made without full consent, in writing, of the Engineer

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling

B. To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling

C. The Contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense
   1. Do not store equipment where conditions fall outside manufacturer's recommendations for environmental conditions
   2. Do not install damaged equipment. Remove environmental conditions from the site, and replace damaged equipment with new equipment
   3. If off-site storage of materials is required, this shall be at the contractor's expense

1.07 COORDINATION

A. Installation Schedule

B. The Contractor shall coordinate with all other trades. Within 10 days of contract being awarded, the Contractor will submit a schedule for the installation
   1. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates
   2. At minimum, the schedule shall provide dates for the start of installation, the completion of horizontal cabling, the completion of riser cabling, the completion of testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance

C. Meeting Attendance and Schedule Adherence

D. The Contractor must attend project-related meetings and adhere to the schedule set by the General Contractor

E. Final Inspection
   1. The Contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment
   2. Within five working days after the final inspection, the Contractor shall send final project documentation and warranty information to the Owner and Engineer. The final project documentation shall include, but not be limited to:
      a. As-Built Drawings, in AutoCAD format, with legible outlet addresses and cable pathways, single line diagrams, enlarged ER/TR room drawings, and rack elevation drawings
      b. Outlet location spreadsheets (cable schedules)
      c. Warranty paperwork
      d. A copy of the Final Inspection and Acceptance Signoff Sheet

1.08 PROJECT CONDITIONS

A. Project Environmental Requirements
   1. Seismic Safety
      a. Provide mechanical and electrical support for all installed equipment as required by all applicable local building codes for earthquake risk hazard zone 4
      b. Anchor all equipment racks with suitable anchors that meet safety standards
      c. Mount overhead devices with appropriate safety attachments as required
      d. Where cabinets and racks are secured directly to the building, this shall be done in accordance with guidance provided by the Authority Having Jurisdiction (AHJ) or a licensed structural engineer
      e. Provide shock and vibration isolation of equipment and fixtures as required
   2. Fiber Optic Cable Safety
      a. The following warnings shall be posted on the job site:
      b. WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED OR LASER SOURCE OR INTO THE END OF A CABLE FIBER CONNECTED TO ONE OR THESE SOURCES.
      c. CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE VISIBLE, YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR WARNING LABELS ON SOURCE DEVICES.
      d. Observe all warning signs on equipment and all written safety precautions in the equipment instruction and technical manuals
      e. Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin

B. Existing Conditions
   1. Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer in writing of any

discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner

2. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and upon approval, proceed with the necessary changes without additional cost to the Owner

C. Record Drawings
   1. Keep a complete set of all telecommunications drawings in the job site office for demonstration of actual installation of work under this Section
   2. Use this set of drawings for no other purpose
   3. Where any material, equipment, or system components are installed differently than what is shown on the Drawings, indicate the differences clearly and neatly using ink or indelible pencil
   4. Upon completion of the project, submit a record set of Drawings

1.09 USE OF THE SITE

A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner

B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, or exits. During the day, set up cones and barriers in hallways and walkways.

C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on how and when to work in these areas

D. Multiple times each day, each installation contractor shall remove all trash and debris from the site

E. Before leaving each day:
   1. The Contractor shall replace all ceiling tiles that they have removed
   2. The Contractor shall place all furniture and equipment that they have moved back into its original location
   3. The Contractor shall return any equipment that they have disconnected to working order
   4. The Contractor's Job Foreman shall inspect all work locations to make sure that the rooms are clean and that all of the tasks described above have been done
   5. It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls

1.10 CONTINUITY OF SERVICES

A. Take no action that will interfere with, or interrupt, existing building services unless previous arrangements have been made with the Owner's representative. Arrange all work to minimize shutdown time

B. The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the contractor shall give five (5) days advance notice

C. Should building services be inadvertently interrupted:
   1. The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services
   2. The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner

1.11 WARRANTY

A. The Contractor shall provide the following warranties for the system and components.
   1. Contractor Materials and Labor Warranty
   2. The Contractor shall provide system warranties, for a 1-year period, against faulty materials and defects in workmanship. The Contractor shall also honor any manufacturer warranties that exceed this period of time

3. Manufacturer Component Warranty
4. All components of the communication room fittings shall be free from manufacturing defects in material or workmanship, under normal and proper usage for a minimum of one (1) year

B. The Manufacturer shall bear the burden to replace or repair any defective products during the warranty period at their cost, including labor and materials

C. The warranty period shall begin on the date of the Owner's Final Acceptance of all Work. Evaluation of quality and workmanship shall be solely by the Owner or the Owner's representatives

1.12 OWNER INSTRUCTION

A. At the time of substantial completion, the Contractor shall submit the system Operation Manual and the Maintenance Data Manual, each neatly bound, with tabbed dividers between sections, and a title page with space for submittal stamps

B. Operation Manual

C. The Operation Manual shall include:
1. A Table of Contents
2. A typed description of each system, including key features and operational concepts such as remote control features, switching or routing functions, patch points, and mixing and linking capabilities
3. Set-up diagrams and typed instructions for use in typical situations, as directed by the Engineer
4. Small-scale plans showing locations and circuit numbers of all system outlets and receptacles
5. Single-line block diagrams showing all major system components
6. Two sets of A-size drawings showing the components and wiring in each individual rack, one drawing of each rack mounted in a plastic jacket on the rear door of the associated rack and a complete drawing set included in the manual
7. Manufacturers' equipment operation manuals intended for use by the system users
8. A properly-licensed working copy of the latest version of any and all software required to operate or configure the systems specified herein, including, but not limited to, all software, firmware, and hardware required for configuration, adjustment, diagnosis, and repair
    a. All software shall be fully documented, and that documentation shall be included in the Operation Manual
    b. Software shall be included in its installable state on industry standard CD-ROM or other appropriate format. Disk images are unacceptable

D. Maintenance Data Manual

E. The Maintenance Data Manual shall include:
1. A Table of Contents
2. The company name, address, telephone number, and contact name for system service or maintenance
3. A listing of all equipment and materials, with the names of the manufacturers and the model numbers or part numbers
4. Catalog data sheets that include the manufacturers' names, addresses, and telephone numbers
5. Product manufacturers' warranties and a typed one-year system warranty explicitly covering all materials and labor
6. The manufacturers' service manuals for all major equipment items
7. Test documentation showing the results of source quality control tests, field quality control tests, acceptance testing, and certification
8. A recommended preventative maintenance schedule with:
    a. References to the applicable pages in the manufacturers' maintenance manuals

b. Where inadequate information is provided by the manufacturer, the information required for proper maintenance

F. Electronic Submittal

G. In addition to hard copy submittals, the Contractor shall submit all files needed to produce the above submittals:
   1. Transportation media \ in Microsoft® structure on CD-ROM or USB flash drive
   2. A Master File List, in text format, on each medium, with a short description of files in the submittal
   3. Drawings in AutoCAD R2010 or later drawing format (.DWG), that include all XREFs, fonts, and other drawing parts required for the drawings
   4. Note: Drawing Exchange File Format (.DXF) is not acceptable.
   5. Word processing files in MS Word 2007 format
   6. Graphs and charts in MS Excel 2007 format
   7. All graphic images required for the reproduction of the submittals in the files in JPEG (.JPG) file format
   8. Manufacturers' data sheets, equipment manuals, and other documentation provided by the manufacturers to the Contractor or documents that are similarly not otherwise available to the Contractor in electronic format shall be excluded from this requirement

1.13 COMMISSIONING

A. Furnish one initial set of product brochures and owner's manuals to the Engineer for use during acceptance testing

PART 2 PRODUCTS

2.01 GENERAL NOTES

A. In this section, certain products are specified by manufacturer and part number to establish a level of quality, performance, and consistency. To substitute other products would defeat this effort to the Owner's detriment. If no manufacturer or part number is specified for a part, then that part is generic, and the Contractor shall submit for approval a part that provides the performance specified herein

B. All rack and cable management products in this section shall be manufactured by Chatsworth Products or an owner approved alternate

C. All materials and products, including Owner Furnished Equipment (OFE), shall be:
   1. Appropriate for the intended use
   2. Recognized as such by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA), or the American National Standards Institute (ANSI)
   3. Permitted for the application by the Authority Having Jurisdiction (AHJ)

D. Electrical components shall bear the UL or ETL label, and this listing shall apply to the entire assembly. Only systems and equipment that meet or exceed the level of quality and the capabilities stated in this document will be considered for acceptance

E. All products shall be new, of the latest version at time of bid, and brought to the job site in the original manufacturer's packaging. Used equipment and damaged material will be rejected

F. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with the manufacturer instructions and these requirements

G. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected

H. All components will be approved by the Engineer and shall have the highest aesthetic value possible while providing the specified functionality. Hardware shall:
   1. Be in compliance with the Construction Documents
   2. Have fit and finish compatible with the existing surrounding structure
   3. Be unobtrusive to the extent practical

4. Provide the required functionality

I. Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of equipment and its installation

J. Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical

2.02 4-POST RACKS

A. 4-post racks shall:
   1. Be manufactured by Chatsworth Products or an owner approved alternate
   2. Model: 15216-703
   3. Be Size:
      a. 96”H x 20.31”W x 25.8”D in IDF’s
      b. 84”H x 20.31”W x 25.8”D in Data Center
   4. Be rated for a maximum of 2,000 pounds of equipment
   5. Be UL listed

B. All racks shall be grounded per the TIA-607 standard and State and local codes

2.03 HORIZONTAL AND VERTICAL CABLE MANAGEMENT

A. The system shall be a complete cable management system that has vertical cable managers, horizontal cable managers, and cable management accessories throughout the cabling system

B. Vertical Cable Management for Racks
   1. Manufacturer: Chatsworth Products or Owner approved alternate
   2. Model: Evolution

C. Horizontal Cable Management for Racks and Enclosures

D. Provide horizontal cable managers as shown on the drawings.
   1. Manufacturer: Chatsworth Products or Owner approved alternate
   2. Model: Evolution 2-RU
   3. Part Number: 35441-702
   4. Dimensions: 3.5”H x 19”W x 8.2”D

2.04 RACK MOUNT POWER DISTRIBUTION UNITS

A. Switched, 24 outlets.

B. Provide two per installed rack
   1. Manufacturer: APC
   2. Model: AP8941

2.05 LADDER RACK

A. Manufacturer: Chatsworth

B. Model: 10250-724

PART 3 EXECUTION

3.01 GENERAL

A. Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer

B. Furnish any special installation equipment or tools necessary to properly complete the installation

C. Failure to follow the appropriate guidelines may require the installer to provide the additional material and labor required to bring the installation back into alignment with the guidelines

D. Provide fire blocking at all fire-rated ceiling, wall, and floor penetrations

E. Plug conduits where cabling has been installed in the main equipment room, backbone, and other cable entrance locations with re-enterable duct seal of flame-retardant putty

F. Provide bushings on all conduit ends

G. All wiring, materials, and equipment must be listed and labeled by an NRTL

H. All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements

I. No self-tapping screws shall be used

J. To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar metals with an inert dielectric material

3.02 4-POST RACKS

A. Before placing any racks, frames, or cabinets, verify that all required power, circuit breakers, building grounding electrode system access, and floor space is in accordance with the contract Drawings

B. Fasten enclosures directly to the structural floor at the four anchor points provided by the manufacturer, using appropriate methods and materials to provide a secure, steadfast installation

C. Horizontally stabilize all equipment racks and bays using materials and methods listed as appropriate for the intended use. Place horizontal stabilizing on at least the first and last racks in a bay and on every second rack. Maximum spacing between horizontal bracing shall be 48 inches

D. On the front and rear of each rack and enclosure, place a machine-generated self-adhesive white label with the identifier, indicated on the Contract Drawings, in black 1-inch black block letters

E. Assemble relay racks according to manufacturer's instructions. Before attaching the rack to the floor, verify that the equipment mounting rails are the proper size for the rack-mount equipment

F. Attach all racks to the floor in four places using appropriate floor-mounting anchors

G. Bond racks to the Secondary Bonding Busbar (SBB) or Mesh-BN using appropriate hardware provided by the Contractor. The ground shall meet local code requirements and shall be approved by the Authority Having Jurisdiction (AHJ)

H. Install additional bracing for racks as required by applicable codes and the recommendations of a licensed structural engineer

I. Cable runway may be attached to the top of the rack, to deliver cables to the rack, but do not drill the rack to attach the runway. Use appropriate hardware from the cable runway manufacturer

J. Evenly distributed and uniformly distribute the equipment load on the rack. Place large and heavy equipment towards the bottom of the rack. Secure all equipment to the rack with appropriate equipment mounting screws

3.03 HORIZONTAL AND VERTICAL CABLE MANAGEMENT

A. Place and install all horizontal and vertical wire and cable management devices and assemblies so as not to impede the efficient use of or connection to adjacent panels, enclosures, or equipment

B. Upon completion of the task, replace all covers, doors, and panels that were removed during the installation

C. Vertical Cable Management
   1. Attach vertical cable managers to the side of the rack or frame according to the manufacturer's installation instructions and using the hardware provided
   2. When a single vertical cable manager is used between two racks or frames, attach the vertical cable manager to both racks or frames
   3. When more than one cable manager is used on a rack or frame or on a group of racks or frames, use the same make, style, and size of vertical cable manager
   4. The color of the cable managers must match the color of the racks or frames

5. After cabling is complete, attach the doors to the cable managers in the closed position

D. Horizontal Cable Managers
   1. When more than one horizontal cable manager is used on a rack, frame, or cabinet, or on a group of racks, frames, or cabinets, use the same make and style cable manager
   2. The color of the cable managers must match the color of the racks or frames
   3. Attach horizontal cable managers to the rack, frame, or cabinet with four screws according to the manufacturer's installation instructions
   4. Place horizontal managers so that the number of ports (cables) they support will not exceed the cable fill capacity of the cable managers
   5. After cabling is complete, attach the covers to the cable managers in the closed position

END OF SECTION 27 1100

SECTION 27 1313

COMMUNICATION COPPER BACKBONE CABLING

PART 1 GENERAL

1.01 SUMMARY

A. This Section (27 1313) includes the specifications for:
   1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on drawings
   2. The specifications for the incorporation of Owner Furnished Equipment (OFE)
   3. The testing, documentation, and instructions for completing the Structured Cabling System
   4. Products supplied but not installed under this section, including loose equipment specified herein, which is to be turned over to the Owner at the completion of this project

B. Owner Furnished Equipment (OFE)

C. Certain equipment may be identified as Owner Furnished Equipment (OFE). This OFE may presently be part of the Owner's system, or may be provided by the Owner and will either be delivered to the Contractor's off-site construction facility, be delivered to the Contractor's on-site secured storage area, or be installed on site by others, as appropriate, for incorporation into the system.
   1. Clean and inspect all OFE.
   2. Notify the Owner in writing of damage, defects, and the extent of any repair or adjustment required for the OFE to meet the original specification.
   3. Service OFE only as directed by the Owner under the arrangements of a separate contract, and incorporate repaired or adjusted OFE into the system as if provided new, except for warranty coverage.

D. Related Drawings
   1. T-Series drawings follow the specifications in this section.
   2. Electrical drawings specify the electrical requirements.
   3. Interior Design drawings specify the interior finishes, spatial relationships between items, and mounting heights.

E. What the Contractor Shall Provide and Install
   1. The Contractor shall furnish and install telecommunications passive equipment, including:
      a. Backbone cable
      b. Terminations
      c. Testing
      d. Administration
   2. Although such work is not specifically mentioned herein or on the drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.
   3. The Contractor shall provide system testing and demonstration, system documentation, and instruction of Owner personnel, without claim for additional payment.

F. Errors or Omissions in Drawings or Documentation
   1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.
   2. Should conflict occur in or between drawings and specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained a written decision (addendum), before submission of the bid, as to which method or materials will be required.

G. Dimensions

H. Dimensions indicated are limiting dimensions.
   1. Do not use equipment exceeding dimensions indicated.
   2. Do not use equipment or arrangements that reduce the required clearances or exceed the specified maximum dimensions.

1.02 REFERENCES

A. Requirements, Codes, and Standards

B. Design, manufacture, test, and install telecommunications cabling networks per the manufacturer's requirements and in accordance with latest revision of the NFPA-70 (National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJs), and the following standards, including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) released at the time of bid:
   1. ANSI/NECA/BICSI 607 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
   2. ANSI/BICSI 002 Data Center Design and Implementation Best Practices
   3. ANSI/TIA 568 Series – Telecommunications Cabling Standards
   4. TIA-569 – Commercial Building Standard for Telecommunications Pathways and Spaces
   5. TIA-606 – Administration Standard for Commercial Telecommunications Infrastructure
   6. TIA-607 – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
   7. TIA-942 – Telecommunications Infrastructure Standard for Data Centers

C. BICSI® Publications

D. Install cabling in accordance with the most recent edition of the following BICSI® Publications
   1. BICSI – Telecommunications Distribution Methods Manual
   2. BICSI – Information Technology Systems Installation Manual

E. Applicability of Codes, Rules, and Regulations
   1. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached.
   2. If the Contractor notes items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's Representative in writing.
   3. Where the requirements of other Sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

F. Manufacturers' Recommendations
   To maintain the applications warranties, install all cabling and termination devices using the manufacturers' recommended installation practices.

G. Definitions
   1. AWG – American Wire Gauge – The standardized wire gauge system for the diameter of round, solid, nonferrous, electrically-conducting wire.
   2. CP – Consolidation Point – A connection facility within Cabling Subsystem 1 for
   3. EDA – Equipment Distribution Area – A space allocated for end equipment, including computer systems and telecommunications equipment.
   4. EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless, that includes the entrance point of the building and continues to the entrance room or space. Also known as Minimum Point of Entry (MPOE).
   5. ER – Equipment Room – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, considered distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment. Also known as Data Center.
   6. IC – Intermediate Cross-connect – A facility enabling the termination of different levels of backbone cabling and interconnection between them or equipment.

7. MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling, or equipment.
8. MDA – Main Distribution Area –The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC).
9. RU – Rack Unit A unit of measure, compliant with EIA 310, used to describe the height of equipment intended for mounting on equipment rails. One RU is 1.75 inches (44.45 mm) high.
10. TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. It is the recognized location of the cross-connect between the backbone and horizontal facilities. Also known as Intermediate Distribution Frame (IDF).

1.03 SYSTEM DESCRIPTION

A. The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR) and between telecommunications spaces. The Contractor will provide and install all required components as identified below.
B. Backbone Cabling
C. Backbone cabling is the portion of the commercial building telecommunications cabling system, excluding equipment cords, that provides interconnections between
   1. Entrance Facilities (EFs)
   2. Equipment Rooms (ERs)
   3. Telecommunications Rooms (TRs)
D. Backbone Cabling Termination
E. For balanced twisted-pair backbone cable, provide IDC-type wiring patch panels at each end, sized for the number of twisted-pair cable assemblies to be installed and rated for Category-6A.

1.04 SUBMITTALS

A. Engineer's Review
   1. The Engineer's review of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the contract documents.
   2. With the shop drawings, the Contractor shall include an index sheet detailing all deviations from the contract documents, and will be held responsible for all deviations, unless the Contractor has received written approval from the Engineer for the specific deviation, separate from general shop drawing approval.
   3. The Engineer's review shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

B. General Component Data

C. For all products covered under this Section, the Contractor shall submit the following data for each component:
   1. A Specification Section reference
   2. The Manufacturer's name
   3. The Manufacturer's model and part number

D. Copper Cable

E. In addition to the general requirements above, the Contractor shall submit the following additional data:
   1. Cable identification numbers
   2. Cable specifications

F. Testing
   1. In addition to the general requirements above, the Contractor shall submit the following additional data:
   2. The equipment serial number and calibration certificate
   3. A graphic diagram documenting the test procedure, including all connectors, the origin, and the destination of each cable tested

G. The Contractor shall submit all test results

1.05 QUALITY ASSURANCE

A. Standards for Materials and Equipment
   1. The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from BICSI, ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.
   2. Electronic equipment provided by the Contractor shall have the UL label where applicable.

B. Installer Qualifications
   1. Registered Communications Distribution Designer (RCDD)
   2. The Contractor must have at least one (1) Registered Communications Distribution Designer (RCDD) as recognized by Building Industry Consulting Service International (BICSI). The RCDD must be a full-time employee of the Contractor, and shall be responsible for compliance of the work with the referenced standards and guidelines. At the time of bid, the RCDD shall provide a professional resume and proof of current registration to the Engineer for approval. The RCDD shall be present during construction and all cable testing and shall have:
      a. Knowledge of BICSI installation standards
      b. Knowledge of NEC standards
      c. Knowledge of ANSI/TIA standards
      d. Certification by the equipment manufacturer as an installer

C. Other Installers
   1. Products shall only be installed and tested by qualified technicians certified by the manufacturer

D. Compliance with Laws, Ordinances, and Codes
   1. As applicable, electronic equipment provided shall have the UL label
   2. Comply in every way with the requirements of local laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. Anything in the plans or specifications that does not strictly comply with the above laws, ordinances, and rules must be referred to the attention of the Engineer for a decision before proceeding. No change in the plans or specifications shall be made without full consent, in writing, of the Engineer

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling
   To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling

B. Storage
   The contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense
   1. Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions
   2. Do not install damaged equipment. Remove environmental conditions from the site, and replace damaged equipment with new equipment
   3. If off-site storage of materials is necessary, this shall be at the Contractor's expense

1.07 COORDINATION

A. Installation Schedule
   The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 10 days of contract award
   1. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates
   2. At minimum, the schedule shall provide dates for the installation start date, the completion of copper cabling, the completion of backbone cabling, the completion of

testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance

B. Meeting Attendance and Schedule Adherence
The Contractor must attend project-related meetings and adhere to the schedule set by the Project Manager

C. Final Inspection
1. The Contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment

1.08 PROJECT CONDITIONS

A. Project Environmental Requirements
1. Existing Conditions
a. Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner
b. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner

B. Record Drawings
1. Keep a complete set of all telecommunications drawings in the job site office for demonstration of the actual installation of work specified in this Section
2. Use this set of drawings for no other purpose
3. Where any material, equipment, or system components are installed differently than what is shown on the drawings, indicate the differences clearly and neatly using ink or indelible pencil
4. Upon completion of the project, submit the record set of drawings

1.09 USE OF THE SITE

A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner

B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, or exits. During the day, set up cones and barriers in hallways and walkways

C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on and when to work in these areas

D. Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving the room each day:
1. The Contractor shall replace all ceiling tiles that they have removed
2. The Contractor shall place all furniture and equipment that they have moved back into its original location
3. The Contractor shall return any equipment that they have disconnected to working order
4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done

1.10 CONTINUITY OF SERVICES

A. Take no action that will interfere with or interrupt the existing building services, unless previous arrangements have been made with the Owner's representative. Arrange all work to minimize shutdown time

B. The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the Contractor shall give five (5) days advance notice

C. Should building services be inadvertently interrupted:
   1. The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services
   2. The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner

1.11 WARRANTY

A. The Contractor shall provide the following warranties for the system and components
   1. Contractor Materials and Labor Warranty
   2. The Contractor shall provide system warranties, for a period specified in the contract documents, against faulty materials and defects in workmanship. The Contractor shall also honor any manufacturer warranties that exceed this period of time
   3. Manufacturer Component Warranty
   4. All components of the structured cabling system shall be free from manufacturing defects in material or workmanship, under normal and proper usage, for a minimum of twenty-five (25) years
   5. Manufacturer System Performance Warranty
   6. The permanent links of the structured cabling system will comply with the standards for balanced twisted pair for end-to-end performance, as defined in ANSI/TIA-568 Telecommunications Standard, for a minimum of twenty-five (25) years
   7. Manufacturer Application Assurance Warranty
   8. The structured cabling system will be free from defects that prevent the operation of standards-based applications and protocols over balanced twisted pair. The applications and protocols shall be those recognized by standards bodies IEEE, ANSI, and ATM Forum and sanctioned specifically for transmission over the specified medium as defined in ANSI/TIA-568, and shall support current and future applications designed for data transmission over the permanent link channel, as defined in the ANSI/TIA-568 telecommunications standard, for a period of twenty-five years

B. The Manufacturer shall bear the burden to replace or repair any defective products during the warranty period at their cost, including labor and materials

C. The warranty period shall begin on the date of the Owner's Final Acceptance of the Work. Evaluation of quality and workmanship shall be solely by the Owner or the Owner's representatives

1.12 OWNER INSTRUCTION

A. At the time of substantial completion, the Contractor shall submit the System Operation Manual and the Maintenance Data Manual, each neatly bound, with tabbed dividers between sections, and a title page with space for submittal stamps

B. Maintenance Data Manual

The Maintenance Data Manual shall include:

   1. A Table of Contents
   2. The company name, address, telephone number, and contact name for system service or maintenance
   3. A list of all equipment and materials, with the names of the manufacturers and the model numbers or part numbers
   4. Catalog data sheets that include the manufacturers' names, addresses, and telephone numbers
   5. Product manufacturers' warranties and a typed one-year system warranty that explicitly covers all materials and labor
   6. The manufacturers' service manuals for all major equipment items
   7. Test documentation showing the results of source quality control tests, field quality control tests, acceptance testing, and certification
   8. A recommended preventative maintenance schedule with:
      a. References to the applicable pages in the manufacturer's maintenance manuals

b. Where inadequate information is provided by the manufacturer, the information necessary for proper maintenance

C. Electronic Submittal

D. In addition to hardcopy submittals, the Contractor shall submit all files needed to produce the above submittals:
   1. Transportation media in Microsoft® structure on CD-ROM or USB flash drive
   2. A Master File List, in text format, placed on each medium, with a short description of files in the submittal
   3. Drawings, in AutoCAD R2010 or later drawing format (.DWG), that include all XREFs, fonts, and other drawing parts required for the drawings
   4. Note: Drawing Exchange File Format (.DXF) is not acceptable
   5. Word processing files in MS Word 2007 format
   6. Graphs and charts in MS Excel 2007 format
   7. All graphic images required for the reproduction of the submittals included in the files in JPEG (.JPG) file format
   8. Manufacturers' data sheets, equipment manuals, and other documentation provided by the manufacturers to the Contractor or documents that are similarly not otherwise available to the Contractor in electronic format shall be excluded from this requirement.

PART 2 PRODUCTS

2.01 GENERAL NOTES

A. In this section, certain products are specified by manufacturer and part number to establish a level of quality, performance, and consistency. To substitute other products would defeat this effort to the Owner's detriment. If no manufacturer or part number is specified for a part, then that part is generic, and the Contractor shall submit for approval a part that provides the performance specified herein.

B. All materials and products, including Owner Furnished Equipment (OFE), shall be:
   1. Appropriate for the intended use
   2. Recognized as such by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA), or the American National Standards Institute (ANSI)
   3. Permitted for the application by the Authority Having Jurisdiction (AHJ)

C. Electrical components shall bear the UL or ETL label, and this listing shall apply to the entire assembly. Only systems and equipment that meet or exceed the level of quality and the capabilities stated in this document will be considered for acceptance

D. All products shall be new, of the latest version at time of bid, and brought to the job site in the original manufacturer's packaging. Used equipment and damaged material will be rejected

E. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements

F. Cable lubricants specifically designed for installing communications cable may be used as needed to reduce pulling tension when pulling cable into conduit

G. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected

H. All components will be approved by the Engineer and shall have the highest aesthetic value possible while providing the specified functionality. Hardware shall:
   1. Be in compliance with the Construction Documents
   2. Have fit and finish compatible with the existing surrounding structure
   3. Be unobtrusive
   4. Provide the required functionality

I. All work area termination hardware, including mounting boxes, faceplates, and outlets, shall match the existing wall surface color as closely as possible

J. Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical factors

2.02 BALANCED TWISTED PAIR CABLE

A. Cabling shall be a CMP listed, 100 ohm, 4-Pair, Unshielded Twisted Pair, compliant with ANSI/TIA-568 for Category 6A performance

B. The outermost jacket must be indelibly printed by the manufacturer, listing the name of the manufacturer, the UL rating, Category-6A rating, and incremental footage markings

C. All four pairs shall be surrounded by a metallic tape, cut into segments to combat the effects of alien crosstalk.

D. Provide (6) Category 6A cables from Data Center to each IDF.

2.03 TERMINATION JACKS

A. The termination jacks shall:
   1. Be patch panel mount eight-pin, eight conductor (8P8C) modular jacks
   2. Have an insulation displacement connector at the rear
   3. Provide color-coding for both T568A and T568B wiring schedules
   4. Be universal in design

B. Shall meet ANSI/TIA-568 requirements for Category 6A connecting hardware

PART 3 EXECUTION

3.01 GENERAL

A. Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer

B. The Contractor shall input the cabling data into the cable management software

C. Provide any screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system

D. Furnish any special installation equipment or tools necessary to properly complete the installation

E. Do not roll or store cable reels without an appropriate underlay

F. Failure to follow the appropriate guidelines may require the installer to provide the additional material and labor required to bring the installation back into alignment with the guidelines. This shall also apply to any and all damages caused to the cables by the installer during the implementation

G. Provide fire blocking at all fire-rated ceiling, wall, and floor penetrations

H. Plug conduits where cabling has been installed in the main equipment room, backbone, and other cable entrance locations with re-enterable duct seal of flame-retardant putty

I. Provide bushings on all conduit ends

J. All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify that performance characteristics meet ANSI/TIA-568 Standards for Category-6A cable, provide all Original Equipment Manufacturer (OEM) documentation to the Owner

K. All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements

L. All cable runs must be continuous. No splices shall be permitted.

M. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation

3.02 WIRING PRACTICES

A. Group and bundle all wiring by power level or signal type

B. Where specific instructions are not given, perform all wiring in strict adherence to standard industry practices as described in the referenced Telecommunications Distribution Methods Manual (TDMM), and ANSI/TIA-568 standards

C. Exercise care in wiring to avoid damaging the cables and equipment. Where conduit or chase nipples are not installed around cutouts or knockouts, use grommets

D. Coordinate with tradespeople in the field, and employ proper installation techniques, including earthing and bonding and adequate ElectroMagnetic Compatibility (EMC).The following table lists the distances that should be maintained between power sources and copper data cabling to avoid ElectroMagnetic Interference (EMI)

condition	*<2kVA*	*2-5kVA*	*>5kVA*
Unshielded power lines or electrical equipment in proximity to open or non-metal pathways	6 inches	12 inches	24 inches
Unshielded power lines or electrical equipment in proximity to grounded metal conduit pathway	3 inches	6 inches	12 inches
Power lines enclosed in a grounded metal conduit (or equivalent shielding (in proximity to grounded metal conduit pathway)	2 inches	6 inches	6 inches
Transformers and Electric Motors	36 inches	36 inches	47 inches
Fluorescent lighting	12 inches	12 inches	12 inches

1. These guidelines apply to properly earth-bonded tray containing communications circuits in parallel with power circuits for a distance of 45 feet or more
2. Communications circuits, contained in properly-bonded ventilated trough tray, shall not be placed in the same cable tray as power circuits

E. All cables installed in vertical tray or chases shall be supported by means of appropriately-sized vertical cable supports on every third floor. Do not use nylon cable ties.

F. Cable Installation in Conduit and Duct Banks
1. When pulling cable, use pulling lubrication
2. During long or difficult runs, use a dynamometer to measure pulling tension. Place the dynamometer between the cable puller and the pull line to monitor pulling tension. Do not exceed the manufacturer's maximum pulling tension
3. Apply pulling grips suitable for use with copper cables to the ends of the cable. Consult the cable manufacturer to determine the appropriate pulling grip and method of attachment. Use breakaway or fuse links at the pulling grip, and ensure that the correct "fuse pin" is installed in the fuse link
4. The bend radius for all cables shall conform to manufacturer's specifications

3.03 PATCH PANELS

A. Install patch panels square and plumb, and fasten them to the mounting rails in four places using manufacturer-supplied screws, with at least one fastener at each corner

B. Install horizontal cable support bars at the rear of all patch panels as indicated on the manufacturer's instructions

C. Attach all accessories supplied with the panels per the manufacturer's instructions

D. Restore all covers, panels, label holders, and accessories removed during the installation of panels to their original places and states

E. On the front and rear of each patch panel, place a machine-generated, self-adhesive white label bearing the panel's identifier, as listed in the submittals, in black ½-inch block letters

3.04 BACKBONE CABLING

A. Install cable in a continuous length from the point of origin to the point of termination. Group all cables and bundle them in the overhead pathways in a neat and workmanlike manner

B. The Contractor shall terminate and test all cables

C. The Contractor shall not exceed the manufacturer's maximum pulling tension

D. Splices shall not be allowed

E. The Contractor shall make sure that all of the materials being installed on this project are of the proper rating required for the pathways and spaces by local, state, and federal codes

F. No cables, including any required service loops, shall be more than 90 meters or 295 feet long. Prior to installation, the Contractor shall identify any area that cannot be reached within these constraints and shall report them to the Engineer. Do not install any data cable outside of these parameters without written approval from the Engineer

G. Install cable paths perpendicular or parallel to the ceiling structure, unless otherwise shown on drawings

H. Do not expose cable to water, paint overspray, paint removal products, or water-based pulling lubricants, as these substances can negatively impact the performance of the cable

3.05 CABLE BUNDLING MATERIALS

A. Use cable bundling and securing materials as required to ensure that cable runs are securely held in place both vertically and horizontally

B. Do not tighten bundling materials or securing devices so as to cause deformation of the inherent cable geometry or construction

C. Do not use cable ties or hook and latch tape to secure cable runs to other building systems (such as electrical conduit, EMT, sprinkler pipes, ceiling suspension members, etc.)

D. In areas considered environment air-handling spaces, only use appropriately-listed materials

3.06 SYSTEM ADMINISTRATION

A. Uniquely identify all components of the installed system by location, function, and unit

B. Supply a Cable Identification Matrix.

C. Supply all records in compliance with ANSI/TIA-606.

D. Provide a cable schedule for administration of the Structured Cabling System described in this Section

3.07 IDENTIFICATION

A. Before installing or terminating cable, confirm all specific labeling requirements with the Owner

B. Cables

C. Mark each backbone cable at each endpoint and at all intermediate pull and access points, and junction boxes with labels that indicate the origination and destination identifiers, the sheath identifier, and the strand or pair range

D. Patch Panels
   1. Label patch panels alphabetically, beginning at the top. Individual ports shall come from the factory labeled with a number designation
   2. Fit all cables with self-laminating labels, bearing the appropriate cable identifier, that surround the outermost jacket. Place the labels within 75 mm (3 inches) of each end of the sheath

3.08 FIELD QUALITY CONTROL

A. General Testing

B. Refer to Section 27 17 00 – Structured Cabling System Testing for complete testing specifications

END OF SECTION 27 1313

SECTION 27 1323

COMMUNICATION FIBER BACKBONE CABLING

PART 1 GENERAL

1.01 SUMMARY

A. This Section (27 1323) includes the specifications for:
   1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on drawings
   2. The specifications for the incorporation of Owner Furnished Equipment (OFE)
   3. The testing, documentation, and instructions for completing the Structured Cabling System
   4. Products supplied but not installed under this section, including loose equipment specified herein, which is to be turned over to the Owner at the completion of this project

B. Owner Furnished Equipment (OFE)

C. Certain equipment may be identified as Owner Furnished Equipment (OFE). This OFE may presently be part of the Owner's system, or may be provided by the Owner, and will either be delivered to the Contractor's off-site construction facility, delivered to the Contractor's on-site secured storage area, or be installed on site by others, as appropriate, for incorporation into the system.
   1. Clean and inspect all OFE.
   2. Notify the Owner in writing of damage, defects, and the extent of repair or adjustment required for the OFE to meet the original specification.
   3. Service OFE only as directed by the Owner under the arrangements of a separate contract, and incorporate repaired or adjusted OFE into the system as if provided new, except for warranty coverage.

D. Related Drawings
   1. T-Series drawings follow the specifications in this section.
   2. Electrical drawings specify the electrical requirements.
   3. Interior Design drawings specify the interior finishes, spatial relationships between items, and mounting heights.

E. What the Contractor Shall Provide and Install
   1. The Contractor shall furnish and install telecommunications passive equipment, including:
      a. Backbone cable
      b. Splicing and terminations
      c. Testing
      d. Administration
   2. Although such work is not specifically mentioned herein or on the drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure and complete installation, without claim for additional payment.
   3. The Contractor shall provide system testing and demonstration, system documentation, and instruction of Owner personnel without claim for additional payment.

F. Errors or Omissions in Drawings or Documentation
   1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.
   2. Should conflict occur in or between drawings and specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum), before submission of the bid, as to which method or materials will be required.

G. Dimensions

H. Dimensions indicated are limiting dimensions
   1. Do not use equipment exceeding the dimensions indicated
   2. Do not use equipment or arrangements that reduce the required clearances or exceed the specified maximum dimensions

1.02 REFERENCES

A. Requirements, Codes, and Standards

B. Design, manufacture, test, and install telecommunications cabling networks per the manufacturer's requirements and in accordance with latest revision of the NFPA-70 (National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJs), and the following standards, including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) released at the time of bid:
   1. ANSI/NECA/BICSI 607 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
   2. ANSI/BICSI 002 Data Center Design and Implementation Best Practices
   3. ANSI/TIA 568 Series – Telecommunications Cabling Standards
   4. TIA-569 – Commercial Building Standard for Telecommunications Pathways and Spaces
   5. TIA-606 – Administration Standard for Commercial Telecommunications Infrastructure
   6. TIA-607 – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
   7. TIA-526 Series – Standard Test Procedures for Fiber Optic Systems
   8. NECA/FOA 301– Installing and Testing Fiber Optic Cables
   9. TIA-942 – Telecommunications Infrastructure Standard for Data Centers

C. Install cabling in accordance with the most recent edition of the following BICSI® Publications:
   1. BICSI – Telecommunications Distribution Methods Manual
   2. BICSI – Information Technology Systems Installation Manual

D. Applicability of Codes, Rules, and Regulations
   1. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached
   2. If the Contractor notes items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's Representative in writing
   3. Where the requirements of other Sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply

E. Manufacturers' Recommendations

F. Install all cabling and termination devices per the manufacturers' recommended installation practices for the applications warranties.

G. Definitions
   1. EDA – Equipment Distribution Area – A space allocated for end equipment, including computer systems and telecommunications equipment.
   2. EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless, that includes the entrance point of the building and continues to the entrance room or space. Also known as Minimum Point of Entry (MPOE)
   3. ER – Equipment Room – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, considered distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment. Also known as Data Center
   4. MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling or equipment.
   5. MDA – Main Distribution Area – The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC).

6. RU – Rack Unit – A unit of measure, compliant with EIA 310, used to describe the height of equipment intended for mounting on equipment rails. One RU is 1.75 inches (44.45 mm) high.
7. TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. It is the recognized location of the cross-connect between the backbone and horizontal facilities. Also known as Intermediate Distribution Frame (IDF)

1.03 SYSTEM DESCRIPTION

A. The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components as identified below.

B. Backbone Cable

C. Backbone cabling will consist of optical fiber cable installed from each TR to the ER.

D. Backbone Cabling Termination
1. Provide fiber distribution enclosures at each end, sized for the number of fibers to be installed.
2. Terminate with field-installable connectors and modular connector panels.

1.04 SUBMITTALS

A. Engineer's Review
1. The Engineer's review of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the contract documents
2. With the shop drawings, the Contractor shall include an index sheet detailing all deviations from the contract documents, and will be held responsible for all deviations unless the Contractor has received written approval from the Engineer for the specific deviation, separate from general shop drawing approval
3. The Engineer's review shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples

B. General Component Data

C. For all products covered under this Section, the Contractor shall submit the following data for each component:
1. A Specification Section reference
2. The Manufacturer's name
3. The Manufacturer's model and part number

D. Fiber Cable
1. In addition to the general requirements above, the Contractor shall submit the following additional data:
2. Cable identification numbers
3. Cable specifications including quantity of fibers, material, insulation, jacket, wavelength, attenuation, diameter, bend radius, core, cladding, coating, buffering, weight, and color

E. Connectors

F. In addition to the general requirements above, the Contractor shall submit the following additional data:
1. Connector specifications

G. Terminations

H. In addition to the general requirements above, the Contractor shall submit terminating tools, materials, and methods.

I. Testing

J. In addition to the general requirements above, the Contractor shall submit the following additional data:

1. The equipment serial number and calibration certificate
2. A graphic diagram documenting the test procedure, including all connectors, the light source, the origin, and the destination of each cable tested

K. Test Results

L. The Contractor shall submit all test results in electronic format native to the testing device.

1.05 QUALITY ASSURANCE

A. Standards for Materials and Equipment
1. The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.

B. Installer Qualifications
1. Registered Communications Distribution Designer (RCDD)
2. The Contractor must have at least (1) Registered Communications Distribution Designer (RCDD) as recognized by Building Industry Consulting Service International (BICSI.) The RCDD must be a full-time employee of the Contractor, and shall be responsible for compliance of the work with the referenced standards and guidelines. At the time of bid, the RCDD shall provide a professional resume and proof of current registration to the Engineer for approval. The RCDD shall be present during construction and all cable testing and shall have:
   a. Knowledge of BICSI installation standards.
   b. Knowledge of NEC standards.
   c. Knowledge of ANSI/TIA standards.
   d. Five (5) years of experience in the installation of optical fiber cables, including splicing, terminating, and testing, including single and multimode
   e. Certification by the manufacturer

C. Other Installers

D. Products shall only be installed by qualified technicians certified by the manufacturer.

E. Compliance with Laws, Ordinances, and Codes
1. As applicable, electronic equipment provided shall have the UL label
2. Comply in every way with the requirements of local laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. Anything in the plans or specifications that does not strictly comply with the above laws, ordinances, and rules must be referred to the attention of the Engineer for a decision before proceeding. No change in the plans or specifications shall be made without full consent in writing of the Engineer

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling

B. To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling

C. Storage

D. The contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the contractor’s expense
1. Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions
2. Do not install damaged equipment. Remove environmental conditions from the site and replace damaged equipment with new equipment
3. If off-site storage of materials is necessary, this shall be at the Contractor’s expense

1.07 COORDINATION

A. Installation Schedule

B. The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 10 days of contract award
    1. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates
    2. As minimum, the schedule shall provide dates for the installation start date, the completion of riser cabling, the completion of testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance.

C. Meeting Attendance and Schedule Adherence

D. The Contractor must attend project-related meetings and adhere to the schedule set by the Project Manager.

E. Final Inspection

F. The Contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment.

G. Within five working days after the final inspection, the Contractor shall send final project documentation and warranty information to the Owner and Engineer.

1.08 PROJECT CONDITIONS

A. Project Environmental Requirements
    1. Fiber Optic Cable Safety
        a. The following warnings shall be posted on the job site:
        b. WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED OR LASER SOURCE OR INTO THE END OF A CABLE FIBER CONNECTED TO ONE OR THESE SOURCES.
        c. CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE VISIBLE, YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR WARNING LABELS ON SOURCE DEVICES.
        d. Observe all warning signs on equipment and all written safety precautions in the equipment instruction and technical manuals
        e. Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin

B. Existing Conditions
    1. Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer in writing of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner
    2. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and upon approval, proceed with the necessary changes without additional cost to the Owner

C. Record Drawings:
    1. Keep a complete set of all telecommunications drawings in the job site office for demonstration of the actual installation of work specified in this Section
    2. Use this set of drawings for no other purpose
    3. Where any material, equipment, or system components are installed differently than what is shown on the drawings, indicate the differences clearly and neatly using ink or indelible pencil
    4. Upon completion of the project, submit the record set of drawings

1.09 USE OF THE SITE

A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner

B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, or exits. During the day, set up cones and barriers in hallways and walkways.

C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on how and when to work in these areas

D. Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving the room each day:
   1. The Contractor shall replace all ceiling tiles that they have removed
   2. The Contractor shall place all furniture and equipment that they have moved back into its original location
   3. The Contractor shall return any equipment that they have disconnected to working order
   4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done

1.10 CONTINUITY OF SERVICES

A. Take no action that will interfere with or interrupt the existing building services, unless previous arrangements have been made with the Owner's representative. Arrange all work to minimize shutdown time

B. The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the Contractor shall give five (5) days' advance notice

C. Should building services be inadvertently interrupted:
   1. The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services
   2. The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner

1.11 WARRANTY

A. The Contractor shall provide the following warranties for the system and components.
   1. Contractor Materials and Labor Warranty

B. The Contractor shall provide system warranties, for a period specified in the contract documents, against faulty materials and defects in workmanship. The Contractor shall also honor any manufacturer warranties that exceed this period of time
   1. Manufacturer Component Warranty

C. All components of the structured cabling system shall be free from manufacturing defects in material or workmanship, under normal and proper usage, for a minimum of twenty-five (20) years.
   1. Manufacturer System Performance Warranty

D. The permanent links of the structured cabling system will comply with the standards for optical fiber for end-to-end performance, as defined in ANSI/TIA-568 Telecommunications Standard, for a minimum of twenty-five (20) years
   1. Manufacturer Application Assurance Warranty
      The structured cabling system will be free from defects that prevent the operation of standards-based applications and protocols over optical fiber. The applications and protocols shall be those recognized by standards bodies IEEE, ANSI, and ATM Forum and sanctioned specifically for transmission over the specified medium as defined in ANSI/TIA-568, and shall support current and future applications designed for data transmission over the permanent link channel, as defined in the ANSI/TIA-568 telecommunications standard, for a minimum period of twenty years

E. The Manufacturer shall bear the burden to replace or repair any defective products during the warranty period at their cost, including labor and materials

F. The warranty period shall begin on the date of the Owner's Final Acceptance of the Work. Evaluation of quality and workmanship shall be solely by the Owner or the Owner's representatives

1.12 OWNER INSTRUCTION

A. At the time of substantial completion, the Contractor shall submit the System Operation Manual and the Maintenance Data Manual, each neatly bound, with tabbed dividers between sections, and a title page with space for submittal stamps

B. Maintenance Data Manual

C. The Maintenance Data Manual shall include:
   1. A Table of Contents
   2. The company name, address, telephone number, and contact name for system service or maintenance
   3. A listing of all equipment and materials, with the names of the manufacturers and the model numbers or part numbers
   4. Catalog data sheets that include the manufacturers' names, addresses, and telephone numbers
   5. Product manufacturers' warranties and a typed one-year system warranty that explicitly covers all materials and labor
   6. Test documentation showing the results of source quality control tests, field quality control tests, acceptance testing, and certification
   7. A recommended preventative maintenance schedule with:
   8. Where inadequate information is provided by the manufacturer, provide best practices information necessary for proper maintenance

D. Electronic Submittal

E. In addition to hard copy submittals, the Contractor shall submit all files needed to produce the above submittals:
   1. Transportation media shall be in Microsoft® structure on CD-ROM or USB flash drive
   2. A Master File List, in text format, placed on each medium, with a short description of files in the submittal
   3. Drawings, in AutoCAD R2010 or later drawing format (.DWG), that include all XREFs, fonts, and other drawing parts required for the drawings
   4. Note: Drawing Exchange File Format (.DXF) is not acceptable.
   5. Word processing files in MS Word 2007 format
   6. Graphs and charts in MS Excel 2007 format
   7. All graphic images required for the reproduction of the submittals included in the files in JPEG (.JPG) file format
   8. Manufacturers' data sheets, equipment manuals, and other documentation provided by the Manufacturers to the Contractor

1.13 COMMISSIONING

A. Furnish one initial set of product brochures and owner's manuals to the Owner for use during acceptance testing and equalization

PART 2 PRODUCTS

2.01 GENERAL NOTES

A. In this section, certain products are specified by manufacturer and part number to establish a level of quality, performance, and consistency. To substitute other products would defeat this effort to the Owner's detriment. If no manufacturer or part number is specified for a part, then that part is generic, and the Contractor shall submit for approval a part that provides the performance specified herein.

B. All materials and products, including Owner Furnished Equipment (OFE), shall be:
   1. Appropriate for the intended use

2. Recognized as such by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA), or the American National Standards Institute (ANSI)
3. Permitted for the application by the Authority Having Jurisdiction (AHJ)

C. Electrical components shall bear the UL or ETL label, and this listing shall apply to the entire assembly. Only systems and equipment that meet or exceed the level of quality and the capabilities stated in this document will be considered for acceptance

D. All products shall be new, of the latest version at time of bid, and brought to the job site in the original manufacturer's packaging. Used equipment and damaged material will be rejected

E. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements

F. Cable lubricants specifically designed for installing communications cable may be used as needed to reduce pulling tension when pulling cable into conduit

G. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected

H. All components will be approved by the Engineer and shall have the highest aesthetic value possible while providing the specified functionality. Hardware shall:
1. Be in compliance with the Construction Documents
2. Have fit and finish compatible with the existing surrounding structure
3. Provide the required functionality

I. All work area termination hardware, including mounting boxes, faceplates, and outlets, shall match the existing wall surface color as closely as possible

J. All fiber products shall be from a single manufacturer

2.02 OPTICAL FIBER CABLES

A. Optical Fiber Strands
1. All optical fibers shall:
a. Be usable and shall meet required specifications
b. Be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification
2. Single-Mode, OS2, tight buffer
a. Manufacturer: Corning
b. Jacket Rating: Plenum
c. Strand Count: (2) 72 strand and (1) 24-strand from each TR to the ER
d. Strand Count: (1) 24-strand from each MPOE to the ER
e. Strand Count: (1) 12-strand from the Rack Room A1063 to the ER
f. Strand Count: (1) 72-strand armored indoor/outdoor rated from the ER to Building 10030 (Corning 072EUZ-T4101DAZ)
3. Single-mode fibers shall meet TIA-492CAAB, “Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak,” and ITU recommendation TG.652, “Characteristics of Single-Mode Optical Fiber Cable.”

B. Fiber Optic Cable Termination
1. Termination shall be to LC-duplex, single mode connectors.

C. Fiber Optic Cable Features
1. The individual fibers shall be color-coded for identification.
a. The optical fiber color coding shall be in accordance with EIA/TIA-598, “Optical Fiber Cable Color-Coding.”
b. The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers.
c. Color-coded buffered fibers shall not adhere to one another.

2. The overall jacket for single-mode cables as specified herein shall be yellow.

2.03 OPTICAL FIBER CONNECTORS

A. Optical fiber connectors shall be manufactured by Corning or an Owner approved alternate and compliant with TIA/EIA-604-10A (LC).

B. Field polish connectors are permitted for use with OS2

C. Connectors must meet or exceed the performance criteria as stipulated in ANSI/TIA-568 and must be manufactured with the following strain relief boots:
   1. A blue strain relief boot to indicate single-mode optical fiber

D. Connectors shall use a precision zirconium ceramic ferrule

E. Connectors shall be made by an ISO 9001 Certified Manufacturer

F. Do not use crimp or screw-on fiber connectors

2.04 OPTICAL FIBER DISTRIBUTION ENCLOSURES

A. All Fiber Distribution Enclosures (FDEs) shall:

B. Be manufactured by Corning or an Owner approved alternate, rack-mounted, metal enclosures with removable doors and panels at front and rear

C. Be designed for cable entry from the rear of the enclosure

D. Be equipped with appropriate means for physically securing the cables in place, and shall provide sufficient rings, saddles, and guides to ensure that all cables and strands are dressed in a neat and workmanlike manner and to maintain the required minimum bend radii for all changes in direction

E. Be equipped with an integral bonding lug or stud for securing the fiber strength member

F. Provide space for twelve vertically installed inserts

G. Use modular snap-in coupler panels

H. Have front and rear access panels be fitted with manufacturer-supplied labels for each enclosure, cable, and all termination positions

I. Have blank connector panels for all available positions

2.05 OPTICAL FIBER CONNECTOR PANELS

A. A connector panel is a modular removable plate containing optical fiber connector adapters or copper jacks.

B. Optical Fiber Couplers
   1. Manufactured by Corning or an Owner approved alternate
   2. Optical fiber couplers shall be a modular unit of the same manufacture as the Fiber Distribution Enclosures, and shall have keyed openings on the front and rear to provide proper alignment of the connectors
   3. Couplers will be factory-installed to maintain an appropriate A-B orientation throughout the optical link
   4. Couplers will be blue for single-mode

C. Connector Panels

D. Connector panels shall:
   1. Be manufactured from cold-rolled steel or injection molded polycarbonate for structural integrity
   2. Be finished with a black powder-coat texture to match other hardware
   3. Have a single mounting footprint
   4. Be available with three, four, six, eight, twelve, or twenty-four connector adapters in each panel
   5. Allow for quick installation and removal
   6. Be available with industry standard single-fiber and small form factor multi-fiber adapters, including TIA/EIA-604-10A (LC)

E. Blank Connector Panels

F. Blank connector panels shall be available to fill unused space in the housings. The blank connector panels shall be:
   1. Attached with at least two push-pull latches to allow for quick installation and removal
   2. Manufactured from injection molded polycarbonate
   3. Finished with a wrinkled black texture to match the housing

PART 3 EXECUTION

3.01 GENERAL

A. Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer

B. The Contractor shall input the cabling data into the cable management software

C. Provide any screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system

D. Furnish any special installation equipment or tools required to properly complete the installation

E. Do not roll or store cable reels without an appropriate underlay

F. Failure to follow the appropriate guidelines may require the installer to provide the additional material and labor required to bring the installation back into alignment with the guidelines. This shall also apply to any and all damages caused to the cables by the installer during the implementation

G. Provide fire blocking at all fire-rated ceiling, wall, and floor penetrations

H. Plug conduits where cabling has been installed in the main equipment room, backbone and other cable entrance locations with re-enterable duct seal of flame-retardant putty

I. Provide bushings on all conduit ends

J. All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify that performance characteristics meet ANSI/TIA-568 Standards, provide all Original Equipment Manufacturer (OEM) documentation to the Owner

K. All techniques and fixtures used in the installation must minimize complexity must allow for easy maintenance of, and ready access to, all components for test measurements

L. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation

3.02 WIRING PRACTICES

A. Where specific instructions are not given, perform all wiring in strict adherence to standard industry practices as described in the referenced Telecommunications Distribution Methods Manual (TDMM), and ANSI/TIA-568 standards

B. Exercise care in wiring to avoid damaging the cables and equipment. Where conduit or chase nipples are not installed around cut outs or knockouts, use grommets

C. Cable Installation in Conduit
   1. Through the entire length of all underground conduits, pull mandrel that is one size smaller than the conduit
   2. During long or difficult runs, use a dynamometer to measure pulling tension. Place the dynamometer between the cable puller and the pull line to monitor pulling tension. Do not exceed the manufacturer's maximum pulling tension
   3. Apply pulling grips suitable for use with fiber optic cables to the ends of the cable. Consult the cable manufacturer to determine appropriate pulling grip and method of

attachment. Use breakaway or fuse links at the pulling grip and ensure that the correct "fuse pin" is installed in the fuse link

4. The bend radius for all cables shall conform to manufacturer's specifications

3.03 OPTICAL FIBER CABLE

A. Install the optical fiber backbone in a continuous length from the assigned FDE in the ER to the assigned FDE within each TR

B. Throughout its length, run the backbone cable in appropriate, listed raceway

C. Leave a 3 m long maintenance loop at each end of the link, neatly contained in the integral management rings and saddles in a "figure 8" loop at the rear of the FDE

D. Throughout the length of the cable, maintain the minimum bend radius and pulling force recommended by the manufacturer and required by industry standards, both during installation and after termination and testing

E. On each end, hold the cable ends securely in place with the cable clamping accessories in each FDE

F. Route individual strands in the rear of the FDE in a neat and orderly fashion, and place them so as not to create undue stress or micro bending of the strands

3.04 OPTICAL FIBER CONNECTORS

A. Place optical fiber connectors, appropriate for the optical fiber type, on all strands in strict accordance with manufacturer instructions and industry standards

B. Perform the installation in strict compliance with all manufacturer instructions.

3.05 FIBER DISTRIBUTION ENCLOSURES

A. Place optical FDEs as depicted on the Drawings

B. Fasten all FDEs to the mounting rails, at the four corners of the enclosure at least, using manufacturer-supplied or manufacturer-approved fasteners

C. Place each FDE in the equipment rack so that it is square and plumb and so that the front face of the FDE is as close as practical to the front face of the rack

D. Install coupler modules in adequate numbers to support all terminated strands

E. Fit all unused module spaces with blank plates

F. To prevent the contamination of unused coupler module faces by airborne particulates, leave the dust caps on all unused faces in place

G. Once you have finished installing the FDEs, replace all covers, doors, and panels that you removed during the installation

H. On the front and rear of each enclosure, place a machine-generated, self-adhesive label with a white background and the FDE's identifier, as listed in submittals, in black 1/2-inch-high block letters

3.06 CABLE BUNDLING MATERIALS

A. Secure all cable bundles with proper bundling or securing materials so as to ensure that the cable runs are securely held in place both vertically and horizontally

B. Do not tighten bundling materials or securing devices so tightly that they deform the inherent cable geometry or construction

C. In environmental air-handling spaces, only use appropriately-listed materials

3.07 SYSTEM ADMINISTRATION

A. Uniquely identify each component of the installed system by location, function, unit, and sub-unit

B. Identify each location with a unique alphanumeric identifier

C. Assign a unique alphanumeric identifier to each equipment enclosure in the building

D. Identify each adapter module installed in each distribution or interconnect enclosure with an alphanumeric identifier

E. Identify each optical fiber cable with a textual label that indicates its type, strand count, point of origin, and termination

F. Supply a Cable Identification Matrix

G. Supply all records in compliance with ANSI/TIA-606

H. Provide a cable schedule compliant for administration of the Structured Cabling System described in this Section

3.08 IDENTIFICATION

A. Before installing or terminating the cabling, confirm all specific labeling requirements with the Owner or the Owner's Engineer

B. Cables

C. Mark each backbone cable at each endpoint and at all intermediate pull and access points and junction boxes with a label that indicates the origination and destination identifiers, the sheath identifier, and the strand range

D. Fiber Distribution Enclosures (FDEs)
   1. Mark each FDE with an adhesive label that indicates the range of circuits installed within it
   2. Label each port with the origination and destination grid identifier and the individual strand ID
   3. At each end of each cable, within 75 mm (3 inches) of the end of the sheath, place a self-laminating label that surrounds the outermost jacket and bears the appropriate cable identifier
   4. On each equipment enclosure, affix self-adhesive labels, bearing the enclosure's identifier in block characters, at the top center of the front and rear doors or faces
   5. In all enclosures, place a label directly adjacent to the shortest side of each adapter that bears that adapter's identifier. Rotate the characters on the labels to maintain a left to right, top to bottom orientation

3.09 FIELD QUALITY CONTROL

A. General Testing

B. Refer to Section 27 17 00 – Structured Cabling System Testing for complete testing specifications

END OF SECTION 27 1323

SECTION 27 1500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.01 SUMMARY

A. This Section (27 1500) includes specifications for:
   1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on the Drawings
   2. The testing, documentation, and instructions for completing the Structured Cabling System
   3. Provide Access Control cabling from the serving IDF control panel to the controlled door locations as noted on security drawings.
   4. Products supplied but not installed under this section, including loose equipment specified herein, which is to be turned over to the Owner at the completion of this project

B. Related Drawings
   1. T-Series drawings follow the specifications in this Section.
   2. Electrical drawings specify the electrical requirements.
   3. Interior Design drawings specify the interior finishes, spatial relationships between items, and mounting height details.

C. What the Contractor Shall Provide and Install
   1. The Contractor shall furnish and install telecommunications passive equipment

D. Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.

E. The Contractor shall provide system testing and demonstration, system documentation, and instruction of Owner personnel, without claim for additional payment.

F. Errors or Omissions in Drawings or Documentation
   1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.
   2. Should conflict occur in or between Drawings and Specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum) before submission of the bid as to which method or materials will be required.

G. Dimensions
   1. Dimensions indicated are limiting dimensions.
   2. Do not use equipment exceeding the dimensions indicated
   3. Do not use equipment or arrangements that reduce the required clearances or exceed the specified maximum dimensions.

1.02 REFERENCES

H. Requirements, Codes, and Standards
   1. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with latest revision of the NFPA-70 (National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJs), and the following standards, including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) released at the time of bid:
      a. ANSI/NECA/BICSI 607 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

b. ANSI/BICSI 002 Data Center Design and Implementation Best Practices
c. ANSI/TIA 568 Series – Telecommunications Cabling Standards
d. TIA-569 – Commercial Building Standard for Telecommunications Pathways and Spaces
e. TIA-606 – Administration Standard for Commercial Telecommunications Infrastructure
f. TIA-607 – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
g. TIA-526 Series – Standard Test Procedures for Fiber Optic Systems
h. NECA/FOA 301– Installing and Testing Fiber Optic Cables
i. TIA-942 – Telecommunications Infrastructure Standard for Data Centers

I. BICSI® Publications

1. Install cabling in accordance with the most recent editions of the following BICSI® publications:
   a. BICSI – Telecommunications Distribution Methods Manual
   b. BICSI – Information Technology Systems Installation Manual

J. Applicability of Codes, Rules, and Regulations

1. Federal, state, and local codes, rules, regulations, and ordinances governing the work are as fully part of the specifications as if herein repeated or hereto attached.
2. If the Contractor notes items in the Drawings or the Specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's representative in writing.
3. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

K. Manufacturers' Recommendations

1. To maintain the applications warranties, install all cabling and termination devices using the manufacturers' recommended installation practices.

L. Definitions

1. AWG – American Wire Gauge – The standardized wire gauge system for the diameter of round, solid, nonferrous, electrically-conducting wire.
2. BD – Building Distributor – A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made.
3. EDA – Equipment Distribution Area – A space allocated for end equipment, including computer systems and telecommunications equipment.
4. EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless, that includes the entrance point of the building and continues to the entrance room or space.
5. ER – Equipment Room – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, considered distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment.
6. HC – Horizontal Cross-connect – A group of connectors, such as patch panels or punch-down blocks, that allow horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers.
7. HDA – Horizontal Distribution Area – A space in a computer room where a Horizontal Cross-connect (HC) is located, and which may include LAN switches, Storage Area Network (SAN) switches, and Keyboard/Video/Mouse (KVM) switches for the end equipment located in the Equipment Distribution Areas (EDAs).
8. IC – Intermediate Cross-connect – A facility enabling the termination of different levels of backbone cabling and interconnection between them or equipment.
9. MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling, or equipment.

10. MDA – Main Distribution Area –The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC).
11. RU – Rack Unit A unit of measure, compliant with EIA 310, used to describe the height of equipment intended for mounting on equipment rails. One RU is 1.75 inches (44.45 mm) high.
12. TO – Telecommunications Outlet – A connecting device, located in a work area, at which the horizontal cabling terminates.
13. TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. It is the recognized location of the cross-connect between the backbone and horizontal facilities.

1.03 SYSTEM DESCRIPTION

A. The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components as identified below.

B. Horizontal Cabling

1. Horizontal cabling includes horizontal cable, telecommunications outlet/connectors in the Work Area (WA), mechanical terminations and patch cords or jumpers located in a Telecommunications Room (TR) or Telecommunications Enclosure (TE).
2. Horizontal cabling includes providing and labeling access control composite cable for card readers, request-to-exit, door contact switches, and door locking hardware. Termination shall be provided by others. Coordinate with Security Equipment vendor.

C. Typical Equipment Room (ER) will consist of the following equipment:

1. Open racks and/or enclosures with vertical and horizontal wire management
2. 24-port or 48-port patch panels for termination of the horizontal cables served from this room
3. Fiber Distribution Enclosures (FDEs)
4. A building-level Uninterruptible Power Supply (UPS) system
5. Rack-mounted Power Outlet Units (POU)
6. One or more racks or enclosures to house network servers and switch equipment
7. A grounding and bonding system connected to the building's main grounding electrode system
8. A cable runway system, installed above the racks and enclosures, to support and manage the cabling that runs from the racks and enclosures to the equipment in the space, which shall be fitted with all accessories required to adequately support the installed cabling, such as waterfalls, support components, and bonding components.

D. Typical Telecommunications Room (TR) will consist of the following equipment:

1. One or more floor-mounted open racks, wall-mounted racks, or enclosures, which shall have horizontal and vertical cable management and, when floor mounted racks are used, horizontal stabilization, which may be provided by the cable runway from the rack to the wall, though if this is insufficient, shall have supports fabricated by the Contractor
2. Termination hardware supporting all horizontal and backbone cabling
3. Rack-mounted FDEs for termination and interconnection of the optical fiber backbone
4. A rack-mounted POU
5. Fire-resistant plywood installed on at least one (1) wall at 96 inches AFF on which to install wall-mounted equipment
6. A grounding and bonding system connected to the building's main grounding electrode system

7. A cable runway system, installed above the racks and enclosures, to support and manage the cabling that runs from the racks and enclosures to equipment in the space, which shall be fitted with all accessories required to adequately support the installed cabling, such as waterfalls, support components, and bonding components

E. Pathways and Raceways

1. Pathways and Raceways are the support system for the infrastructure. All pathways and raceways shall conform to the standards referenced in this Section.
2. All horizontal and backbone cable shall be properly supported every 48 inches to 60 inches. Infrastructure support systems include, but may not be limited to the following:
   a. Properly-supported cable trays and cable runway
   b. Properly-supported conduits, inside or outside, above ground or underground
   c. Non-continuous cable supports, which shall be spaced no more than 60 inches apart
   d. Surface raceway systems that may consist of metallic or non-metallic raceways and boxes

F. Using a Combination of Cable Supports

1. The preferred method for providing pathways is to use a combination of cable tray and non-continuous cable supports.
2. Cable trays shall be used for main horizontal cable pathways on all levels from the ER and TR locations.
3. Cable trays shall be installed in the main corridors.
4. In areas of low cable density, use independently-supported non-continuous cable supports in lieu of the cable tray system.
5. All backbone cable shall also follow these cable tray pathways.
6. Horizontal and auxiliary system cables shall be combed and independently bundled. Bundle ties shall be easily removed for the addition or removal of cables and shall be plenum rated.
7. To allow for future maintenance and access, the primary cable routes shall be located over corridors.
8. To protect cable from damage and to provide a suitable aesthetic appearance in areas where the cable may be exposed, such as in open-ceiling rooms, conduit or surface raceway must be used instead of non-continuous cable supports.

1.04 SUBMITTALS

A. Engineer's Review

1. The Engineer's review of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the contract documents.
2. With the shop drawings, the Contractor shall include an index sheet detailing all deviations from the contract documents, and will be held responsible for all deviations, unless the Contractor has received written approval from the Engineer for the specific deviation, separate from general shop drawing approval.
3. The Engineer's review shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

B. General Component Data

For all products covered under this Section, the Contractor shall submit the following data for each component:

1. A Specification Section
2. The Manufacturer's name.
3. The Manufacturer's model and part number

C. Copper Cable and Patch Cords

1. In addition to the general requirements above, the Contractor shall submit the following additional data:
    a. Cable specifications including quantity of pairs, material, insulation, performance, attenuation, Near-End CrossTalk (NEXT), diameter, conductor size, jacket, weight, and color
    b. The length of the patch cords
    c. The connector type for the patch cords

D. Fiber Cable and Patch Cords

1. In addition to the general requirements above, the Contractor shall submit the following additional data:
2. Cable identification numbers
3. Cable specifications including quantity of fibers, material, insulation, jacket, wavelength, attenuation, diameter, bend radius, core, cladding, coating, buffering, weight, and color
4. The length of the patch cords
5. The connector type for the patch cords

E. Devices

1. In addition to the general requirements above, the Contractor shall submit the following additional data for outlets, cover plates, and fiber connectors:
    a. The outlet specifications, including category rating, material, wiring, termination type, wire type, and color
    b. The associated faceplate
    c. A drawing of each device

F. Connecting Hardware

1. In addition to the general requirements above, the Contractor shall submit the equipment specifications for copper patch panels, fiber patch panels, and wiring blocks, including quantity of ports, material, dimensions, mounting, terminating devices and color.

G. Connectors

1. In addition to the general requirements above, the Contractor shall submit the following additional data:
    a. Connector specifications, including material, dimensions, attenuation, NEXT connection losses, ratings, and construction
    b. A drawing of the equipment

H. Splicing and Terminations

1. In addition to the general requirements above, the Contractor shall submit the splicing and terminating tools, materials, and methods.

I. Testing

1. In addition to the general requirements above, the Contractor shall submit the following additional data:
2. The equipment serial number
3. A graphic diagram documenting the test procedure, including all connectors, the light source (as applicable,) the origin, and the destination of each cable tested.

J. Test Results

1. The Contractor shall submit all test results.

1.05 QUALITY ASSURANCE

A. Standards for Materials and Equipment

1. The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.

2. Electronic equipment provided by the Contractor shall have the UL label where applicable.

B. Installer Qualifications

1. Registered Communications Distribution Designer (RCDD)
2. The Contractor must have at least one (1) Registered Communications Distribution Designer (RCDD) as recognized by Building Industry Consulting Service International (BICSI.) The RCDD must be a full-time employee of the Contractor, and shall be responsible for compliance of work with the referenced standards and guidelines. At the time of bid, the RCDD shall provide a professional resume and proof of current registration to the Engineer for approval. The RCDD shall be present during construction and all cable testing and shall have:
    a. Knowledge of BICSI installation standards
    b. Knowledge of NEC standards
    c. Knowledge of ANSI/TIA standards
    d. Five (5) years of experience in the installation of optical fiber cables, including splicing, terminating, and testing including single and multimode.
    e. Three (3) years of experience in the installation of balanced twisted pair copper cables for voice and data distribution systems, including splicing, terminating, testing, and complete verification of compliance with ANSI/TIA cable standards

C. Other Installers

1. Products shall only be installed by qualified technicians certified by the manufacturers.

D. Provide all electronic equipment with a UL label when applicable.

E. Compliance with Laws, Ordinances, and Codes

1. As applicable, electronic equipment provided shall have the UL label.
2. Comply in every way with the requirements of local laws and ordinances, the National Board of Fire Underwriters, and the National Electrical Code. Anything in the plans or specifications that does not strictly comply with the above laws, ordinances, and rules must be referred to the attention of the Engineer for a decision before proceeding. No change in the plans or specifications shall be made without full consent, in writing, of the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage

1. The contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor’s expense.
2. Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions.
3. Do not install damaged equipment. Remove environmental conditions from the site, and replace damaged equipment with new equipment.
4. If off-site storage of materials is necessary, this shall be at the Contractor’s expense.

1.07 COORDINATION

A. Installation Schedule

1. The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 10 days of contract award.
2. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.
3. At minimum, the schedule shall provide dates for the start of demolition, the completion of demolition, the installation start date, the completion of copper cabling, the completion of backbone cabling, the completion of testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance.

B. Meeting Attendance and Schedule Adherence

The Contractor must attend all project-related meetings and adhere to schedule set by the Project Manager.

C. Final Inspection

1. The Contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment.
2. Within five working days after the final inspection, the Contractor shall send final project documentation and warranty information to the Owner and Engineer. The final project documentation shall include, but may not be limited to:
    a. As-Built Drawings, in an AutoCAD format, with legible outlet address and cable paths
    b. Outlet location spreadsheets
    c. Warranty paperwork
    d. A copy of the Final Inspection and Acceptance Signoff Sheet
    e. Photos of each ER and TR

1.08 PROJECT CONDITIONS

A. Project Environmental Requirements

1. Seismic Safety
    a. Provide mechanical and electrical support for all installed equipment as required by all applicable local building codes for this installation's earthquake risk hazard zone and as recommended by Telcordia Specification GR-63.
    b. Anchor all equipment racks with suitable anchors that meet safety standards.
    c. Mount overhead devices with appropriate safety attachments as required.
    d. Where cabinets and racks are secured directly to the building, this shall be done in accordance with guidance provided by the Authority Having Jurisdiction (AHJ) or a structural engineer.
    e. Provide shock and vibration isolation of equipment and fixtures as required.
2. Fiber Optic Cable Safety
    a. The following warnings shall be posted on the job site:
    WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED OR LASER SOURCE OR INTO THE END OF A CABLE FIBER CONNECTED TO ONE OR THESE SOURCES.
    CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE VISIBLE, YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR WARNING LABELS ON SOURCE DEVICES.
    b. Observe all warning signs on equipment and all written safety precautions in the instruction and technical manuals.
    c. Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin.
3. Existing Conditions
    a. Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.
    b. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner.

B. Record Drawings

1. Keep a complete set of all telecommunications drawings in the job site office for demonstration of the actual installation work specified in this Section.
2. Use this set of drawings for no other purpose.
3. Where any material, equipment, or system components are installed differently than what is shown on the drawings, indicate the differences clearly and neatly using ink or indelible pencil.
4. Upon completion of the project, submit the record set of drawings.

1.09 USE OF THE SITE

A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.

B. When proceeding with the work, do not interfere with the ordinary use of aisles, passages, or exits.

C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on and when to work in these areas.

D. Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving the room each day:

1. The Contractor shall replace all ceiling tiles that they have removed.
2. The Contractor shall place all furniture and equipment that they have moved back into its original location.
3. The Contractor shall return any equipment that they have disconnected to working order.
4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.

1.10 CONTINUITY OF SERVICES

A. Take no action that will interfere with or interrupt existing building or campus services, unless previous arrangements have been made with the Owner's representative(s). Arrange all work to minimize shutdown time.

B. The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the Contractor shall give three (3) days advance notice.

C. Should building services be inadvertently interrupted:

1. The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services.
2. The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner.

1.11 WARRANTY

A. The Contractor shall provide the following warranties for the system and components.

1. Contractor Materials and Labor Warranty
   The Contractor shall provide system warranties, for a period specified in the contract documents, against faulty materials and defects in workmanship. The Contractor shall honor any manufacturer warranties that exceed this period of time.
2. Manufacturer Component Warranty
   All components of the structured cabling system shall be free from manufacturing defects in material or workmanship, under normal and proper usage, for a minimum of twenty-five (25) years.
3. Manufacturer System Performance Warranty
   The permanent links of the structured cabling system will comply with the standards for balanced twisted pair and optical fiber for end-to-end performance, as defined in ANSI/TIA-568 Telecommunications Standard, for a minimum of twenty-five (25) years.
4. Manufacturer Application Assurance Warranty

5. The structured cabling system will be free from defects that prevent the operation of standards-based applications and protocols over balanced twisted pair and optical fiber. The applications and protocols shall be those recognized by standards bodies IEEE, ANSI, and ATM Forum and sanctioned specifically for transmission over the specified medium as defined in ANSI/TIA-568, and shall support current and future applications designed for data transmission over the permanent link/ channel, as defined in ANSI/TIA-568 telecommunications standard, for a period of twenty-five years.

B. The Manufacturer shall bear the burden to replace or repair any such defective products during the warranty period at their cost, including labor and materials.

C. The warranty period shall begin on the date of the Owner's Acceptance of the Work. Evaluation of quality and workmanship shall be solely by the Owner or the Owner's representatives.

1.12 OWNER INSTRUCTION

A. At the time of substantial completion, the Contractor shall submit the System Operation Manual and the Maintenance Data Manual, each neatly bound, with tabbed dividers between sections, and a title page with space for submittal stamps.

B. Maintenance Data Manual shall include:

1. A Table of Contents
2. The company name, address, telephone number, and contact name for system service or maintenance
3. A list of all equipment and materials, with the names of the manufacturers and the model numbers or part numbers
4. Catalog data sheets that include the manufacturers' names, addresses, and telephone numbers
5. Product manufacturers' warranties and a typed one-year system warranty that explicitly covers all materials and labor
6. The manufacturers' service manuals for all major equipment items
7. Test documentation showing the results of source quality control tests, field quality control tests, acceptance testing, and certification
8. A recommended preventative maintenance schedule with:
   a. References to the applicable pages in the manufacturer's maintenance manuals
   b. Where inadequate information is provided by the manufacturer, the information necessary for proper maintenance

C. Electronic Submittal

1. In addition to hard copy submittals, the Contractor shall submit all files needed to produce the above submittals:
   a. Transportation media shall be in Microsoft® structure on CD-ROM or USB flash drive
   b. A Master File List, in text format, placed on each medium, with a short description of files in the submittal
   c. Drawings, in AutoCAD R2010 or later drawing format (.DWG), that include all XREFs, fonts, and other drawing parts required for the drawings
   d. Word processing files in MS Word 2007 format
   e. Graphs and charts in MS Excel 2007 format
   f. All graphic images required for the reproduction of the submittals included in the files in JPEG (.JPG) file format
   g. Manufacturers' data sheets, equipment manuals, and other documentation provided by the Manufacturers to the Contractor or documents that are similarly not otherwise available to the Contractor in electronic format shall be excluded from this requirement.

1.13 COMMISSIONING

A. Furnish one initial set of drawings and cable schedules to the Owner for use during acceptance testing and equalization.

PART 2 PRODUCTS

2.01 GENERAL NOTES

A. In this section, certain products are specified by manufacturer and part number to establish a level of quality, performance, and consistency. To substitute other products would defeat this effort to the Owner's detriment. If no manufacturer or part number is specified for a part, then that part is generic, and the Contractor shall submit for approval a part that provides the performance specified herein.

B. All materials and products, including Owner Furnished Equipment (OFE), shall be:

1. Appropriate for the intended use
2. Recognized as such by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA) or the American National Standards Institute (ANSI)
3. Permitted by the Authority Having Jurisdiction (AHJ)

C. Electrical components shall bear the UL or ETL label, and this listing shall apply to the entire assembly. Only systems and equipment that meet or exceed the level of quality and the capabilities stated in this document will be considered for acceptance.

D. All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Used equipment and damaged material will be rejected.

E. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

F. Cable lubricants specifically designed for installing communications cable may be used as needed to reduce pulling tension when pulling cable into conduit.

G. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.

H. All components will be approved by the Engineer and shall have the most aesthetic value possible while maintaining specified functionality. Hardware shall:

1. Be in compliance with the Construction Documents
2. Have fit and finish compatible with the existing surrounding structure
3. Be unobtrusive
4. Provide the required functionality

I. All work area termination hardware, including mounting boxes, faceplates, and outlets, shall match the existing wall surface color as closely as possible.

J. All copper and fiber products shall be from a single manufacturer so that a single performance warranty covers all applications on vertical and horizontal links.

K. Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of the equipment and its installation.

L. Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical factors.

2.02 FIELD-TERMINATED PATCH PANELS

A. Patch panels for field termination of Category [insert 6 or 6A] Unshielded Twisted Pair (UTP) cable shall:

1. Be flat 19-inch rack-mountable panels
2. B**e** 2RU**,** 48-port units
3. Have 8-pin modular Insulation Displacement Connectors (IDCs) that:
   a. Meet Category 6A performance standards
   b. Support T568A and T568B wiring schedules
4. Have space on the front and rear of all jacks for labeling and identification

5. Have a steel frame, with a black power-coat finish, in 48-port configurations
6. Accommodate at least 24 ports for each Rack Unit (RU)
7. Have circuit boards tested in both directions, as required by ANSI/TIA-568
8. Meet the requirements of IEEE 802.af and IEEE 802.3at for PoE applications
9. Have 110-style IDCs on which termination is accomplished with a single conductor impact tool
10. Allow for a minimum of 20 re-terminations without signal degradation below the limit specified by industry standards
11. Have modular ports that are in compliance with FCC CFR 47 part 68, subpart F and IEC 60603-7 with 50 micro--inches of gold plating over nickel contacts or equivalent
12. Be made by an ISO 9001 Certified Manufacturer
13. Have horizontal cable support bars from the same manufacturer as the patch panels
14. Manufactured by Panduit or approved alternate

2.03 HORIZONTAL UTP CABLE

A. Copper Horizontal cabling shall be:

1. CMP- listed**,** 100 ohm, 4-pair, Unshielded Twisted Pair (UTP)
2. In compliance with ANSI/TIA-568 for Category 6 for TO ports 1-4
3. In compliance with ANSI/TIA-568 for Category 6A for TO port 5 and 6
4. Manufacturer: Panduit

B. The outermost jacket must be indelibly printed by the manufacturer with the name of the manufacturer, the UL rating, and incremental footage markings.

C. For Cat 6A cables, all four pairs shall be surrounded by a metallic tape, cut into segments to combat the effects of alien crosstalk.

2.04 COMPOSITE ACCESS CONTROL CABLE

A. Composite Access Control cabling shall be:

1. Windy City Wire - Part# 4461030-S500

2.05 MULTI-MODE OPTICAL FIBER CABLE

A. Corning MTP Trunk, OM4, 50-micron, 12-strand

B. Corning MTP, Multi-mode, 6-adapter coupler panel in IDF

C. Corning MTP, Multi-mode, single port coupler module at station end

2.06 FACEPLATES AND JACKS

A. UTP Jacks shall:

1. Be flush-mount eight-pin, eight conductor (8P8C) modular jacks
2. Have an Insulation Displacement Connector (IDC) on the rear
3. Provide color-coding for both T568A and T568B wiring schedules
4. Be universal in design
5. Meet ANSI/TIA-568 requirements for Category 6A connecting hardware
6. Must accept 2-pair, 3-pair, or 4-pair modular plugs without damage to the outer jack contacts

B. Fiber Optic MPO/LC Fiber Optic Adapters

1. 12-strand MPO connector with LC break-out.

C. Faceplates shall:

1. Be single-gang or double-gang
2. Of the same manufacturer as the jacks
3. Supplied in colors and finishes coordinated with the Architect
4. Have the capability for integral labeling and identification
5. Provide capacity for a maximum of six individual jacks for single-gang applications

2.07 CORDAGE

A. Unshielded Twisted Pair (UTP) Patch Cables

1. Patching, equipment, and station cords shall be factory manufactured. The use of field-manufactured cordage is not permitted.
2. All cords shall be constructed of four twisted pair of stranded conductors terminated to industry standard 8P8C modular plug at both ends.
3. Colors shall be coordinated with and approved by the Owner.
4. Wiring schedule shall match that of patch panels and outlets.
5. Cordage shall be of the same manufacturer as modular jacks, patch panels, and connecting/termination blocks.
6. Station cords shall be 10 feet long.
7. Equipment cords shall be 8" long.
8. Quantities:
   a. Telecom Rooms – Provide (1) patch cord for each installed port
   b. Work Area Outlet – Provide (1) Cat-6A and (1) Cat-6 patch cords for each installed work area outlet

B. Optical Fiber

1. All optical fiber patch cords shall be 1.8 mm duplex (zip-cord), containing optical fiber strands equal to that specified for interior cabling, and shall match the type (graded-index or single-mode) connected to each cord.
2. All cords shall be terminated to factory-polished duplex LC connectors and shall be fully in compliance with ANSI/TIA-568-C.3 standards for performance to 1000 Mb/s.
3. The end-faces of all patch cords shall be of a Universal Positive Contact (UPC) configuration.
4. Field-terminated cable assemblies are not permitted.
5. Quantities and lengths of cords shall be coordinated with and approved by the Engineer.
6. Cordage will be of the same manufacturer as that selected for the optical fiber and associated connectors.

C. Cable Bundling Materials

1. Provide hook and loop tape, that is at least 0.5 inches wide, of a length equal to 150% of the circumference of the cable bundle.
2. Do not use tie wraps on this project.
3. When used in areas considered environmental air spaces, all bundling materials must be appropriately listed.

PART 3 EXECUTION

3.01 GENERAL

A. Upon completion of the work, a Registered Communications Distribution Designer (RCDD) shall submit record drawings to the Owner and to the Engineer.

B. The Contractor shall input the cabling data into the cable management software.

C. Install voice and data cable, an outlet, and a jack at each location designated on the Drawings.

D. Provide any required screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.

E. Furnish any special installation equipment or tools necessary to properly complete the installation.

F. Do not roll or store cable reels without an appropriate underlay.

G. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to properly rectify the situation. This shall also apply to any and all damages caused to the cables by the installer during the implementation.

H. Provide UL Listed fire blocking system at all fire rated penetrations.

I. Provide bushings on all conduit ends.

J. All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify that performance characteristics meet ANSI/TIA-568 Standards, provide all Original Equipment Manufacturer (OEM) documentation to the Owner.

K. All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements.

L. No self-tapping screws shall be used.

M. All materials used in installation shall be resistant to fungus growth and moisture deterioration.

N. To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar metals with an inert dielectric material.

O. All cable runs must be continuous from patch panel to the outlet location.

P. Place electrical components at outlets (such as impedance matching devices) outside the faceplate using a standard plug connection.

Q. All empty innerduct or conduit shall include a non-corrosive pull-rope.

R. Turn all spare patch cables over to the Owner.

S. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.02 WIRING PRACTICES

A. Group and bundle all wiring by signal type.

B. Where specific instructions are not given, perform all wiring in strict adherence to standard industry practices as described in the referenced Telecommunications Distribution Methods Manual (TDMM), and ANSI/TIA-568 standards.

C. Exercise care in wiring to avoid damaging the cables and equipment. Where conduit or chase nipples are not installed around cutouts or knockouts, use grommets.

D. Provide 2-meter service loop in telecom rooms for UTP and fiber cables. Provide 12” service loop for fiber at work area outlet. Provide 2” service loop for UTP at work area outlet.

E. Where wiring of different classifications share a common enclosure or junction box, separate wiring groups.

F. Cables shall not be spliced.

G. All cables installed in vertical tray or chases shall be supported by means of appropriately-sized vertical cable supports on every third floor. Do not use nylon cable ties.

3.03 PATCH PANELS

A. Install patch panels in the equipment racks. Confirm panels position in rack with Owner.
   1. Install patch panels square and plumb, and fasten them to the mounting rails in four places using manufacturer-supplied screws, with at least one fastener at each corner.
   2. Install horizontal cable support bars at the rear of all patch panels as indicated on the manufacturer’s instructions.

B. Attach all accessories supplied with the panels per the manufacturer’s instructions.
   1. Restore all covers, panels, label holders, and accessories removed during the installation of panels to their original places and states.
   2. On the front and rear of each patch panel, place a machine-generated, self-adhesive white label bearing the panel’s identifier, as listed in the submittals, in black ½-inch block letters.

3.04 HORIZONTAL UTP

A. Install horizontal cable in a continuous length from the point of origin to the point of termination. Group all cables and bundle them in the overhead pathways in a neat and workmanlike manner.

B. The Contractor shall terminate and test all cables.

C. The Contractor shall not exceed the manufacturer's maximum pulling tension.

D. Splices shall not be allowed.

E. No horizontal cables, including any required service loops, shall be more than 90 meters or 295 feet long. Prior to installation, the Contractor shall identify any area that cannot be reached within these constraints and shall report them to the Engineer. Do not install any data cable outside of these parameters without written approval from the Engineer.

F. Do not expose cable to water, paint overspray, paint removal products, or water-based pulling lubricants, as these substances can negatively impact the performance of the cable.

3.05 FACEPLATES AND JACKS

A. Faceplates
   1. Provide faceplates in the configurations and quantities indicated on the Contract Drawings.
   2. Fit faceplates to associated device boxes using appropriate adapters.
   3. Install all faceplates square and plumb.
   4. Within each faceplate, orient all UTP jacks with the locking tab at the bottom.

B. Terminations
   1. At the jack, remove the minimum amount of outer jacket.
   2. Maintain the inherent Twists Per Inch (TPI) of UTP cable to within ½ inch of the termination.
   3. Where provided, fit dust caps to all jacks.

C. Wall Mounted Telephone Outlets. On each telephone outlet:
   1. Install a 4-inch square box with a single-gang mounting plate.
   2. Affix a stainless-steel faceplate, with an un-keyed 8-pin modular jack and wall telephone mounting lugs.

3.06 OPTICAL FIBER CABLE

A. Install the optical fiber in a continuous length from the FDE in the TR to the TO.

B. Throughout its length, run the cable in appropriate, listed raceway.

C. Leave a 3 m long maintenance loop at each end of the link, neatly contained in the integral management rings and saddles in a "figure 8" loop at the rear of the FDE.

D. Throughout the length of the cable, maintain the minimum bend radius and pulling force recommended by the manufacturer and required by industry standards, both during installation and after termination and testing.

E. On each end, hold the cable ends securely in place with the cable clamping accessories in each FDE.

3.07 OPTICAL FIBER MPO CASSETTES

A. Install fiber cassettes in strict compliance with the manufacturer's instructions and requirements.

3.08 FIBER DISTRIBUTION ENCLOSURES

A. Place optical FDEs as depicted on the Drawings.

B. Fasten all FDEs to the mounting rails, at the four corners of the enclosure at least, using manufacturer-supplied or manufacturer-approved fasteners.

C. Place each FDE in the equipment rack so that it is square and plumb and so that the front face of the FDE is as close as practical to the front face of the rack.

D. Install coupler modules in adequate numbers to support all terminated strands.

E. Fit all unused module spaces with blank plates.

F. To prevent the contamination of unused coupler module faces by airborne particulates, leave the dust caps on all unused faces in place.

G. Once you have finished installing the FDEs, replace all covers, doors, and panels that you removed during the installation.

H. On the front and rear of each enclosure, place a machine-generated, self-adhesive label with a white background and the FDE's identifier in black 1/2-inch-high block letters.

3.09 FACTORY-TERMINATED OPTICAL FIBER CABLE ASSEMBLIES

A. All cable assemblies will be constructed and tested at the manufacturer's facilities.

B. Install optical fiber cable assemblies in a continuous length from the point of origin to the point of termination as shown on the Drawings.

C. Throughout their length, run the optical fiber cable assemblies in appropriate, listed raceway.

D. Leave a 3 m long maintenance loop at each end of the link, neatly contained in the integral management rings and saddles in a "figure 8" loop at the rear of the FDE.

E. Throughout the length of the cable, maintain the minimum bend radius and pulling force recommended by the manufacturer and required by industry standards, both during installation and after termination and testing.

F. On each end, hold the cable ends securely in place with the cable clamping accessories in each FDE.

3.10 BALANCED TWISTED PAIR CORDAGE

A. Install equipment and station cords as directed by the Owner.

B. Route equipment cords in appropriate cable management accessories and maintain all required bend radius limits as specified by industry standards.

C. In racks and cabinets, separately route equipment cords along the longitudinal axis of the rack or cabinet so that no cord traverses the vertical centerline of the cabinet or rack except in an enclosed horizontal cable management panel.

D. Use equipment cords of sufficient length to allow each end of the cord to terminate at the appropriate interface without excessive strain or violation of the minimum bend radius for the selected medium.

3.11 OPTICAL FIBER CORDAGE

A. Install equipment and station cords as directed by the Owner.

B. Route equipment cords in appropriate cable management accessories and maintain all required bend radius limits as specified by industry standards.

C. In racks and cabinets, separately route equipment cords along the longitudinal axis of the rack or cabinet so that no cord traverses the vertical centerline of the cabinet or rack except in an enclosed horizontal cable management panel.

D. Use equipment cords of sufficient length to allow each end of the cord to terminate at the appropriate interface without excessive strain or violation of the minimum bend radius for the selected medium.

3.12 CABLE BUNDLING MATERIALS

A. Use cable bundling and securing materials as required to ensure that cable runs are securely held in place both vertically and horizontally.

B. Do not tighten bundling materials or securing devices so as to cause deformation of the inherent cable geometry or construction.

C. Do not use cable ties or hook and latch tape to secure cable runs to other building systems (such as electrical conduit, EMT, sprinkler pipes, ceiling suspension members, etc.).

D. In areas considered environment air-handling spaces, only use appropriately-listed materials.

3.13 SYSTEM ADMINISTRATION

A. Uniquely identify all components of the installed system by location, function, unit, and sub-unit.

B. Identify each location with a unique alphanumeric identifier.

C. Assign a unique alphanumeric identifier for each equipment enclosure in the building.

D. Identify each adapter module in each distribution or interconnect enclosure with an alphanumeric identifier.

E. Identify all conduits, trays, and pathways with a unique alphanumeric identifier.

F. Identify optical fiber cables by a textual label that indicates its type, strand count, point of origin, and termination.

G. Supply a Cable Identification Schedule (Matrix)

H. Supply all records in compliance with ANSI/TIA-606.

3.14 IDENTIFICATION

A. Before installing or terminating cable, confirm all specific labeling requirements with the Owner or the Owner's Engineer.

B. Cables
   1. Mark each cable at each endpoint and at all intermediate pull and access points, and junction boxes with labels that indicate the origination and destination identifiers, the sheath identifier, and the strand or pair range.
   2. Mark each horizontal cable on the sheath at each end with the TR, patch panel, and panel port to which the cable is wired. Mark block-terminated cables with a V in place of the panel ID.

C. Faceplates, Patch Panels, and Wiring Blocks
   1. Mark each FDE with an adhesive label that indicates the range of circuits installed in it. Label each port with the origination and destination grid identifier and the individual strand ID.
   2. Label patch panels alphabetically, beginning at the top. Individual ports shall come from the factory labeled with a number designation.
   3. For each cable that a faceplate houses, label the faceplate to indicate the TR, patch panel, and panel port to which the cable is wired.
   4. Fit all cables with self-laminating labels, bearing the appropriate cable identifier, that surround the outermost jacket. Place the labels within 75 mm (3 inches) of each end of the sheath.
   5. Fit all equipment enclosures with a self-adhesive label, bearing the enclosure's respective identifier, affixed to the top center of the front and rear doors.
   6. Fit each Fiber Distribution Enclosure with a self-adhesive label, affixed, bearing the enclosure's respective identifier in block characters, at the top center of the front and rear face.
   7. Fit each adapter in each enclosure with a label, bearing the identifier, affixed directly adjacent to the adapter's shortest side. Rotate characters to keep their orientation left to right, top to bottom.

D. Conduits and Pathways
   1. Label conduits and pathways within 0.5 m (18 inches) of each end, where exposed and accessible.

3.15 FIELD QUALITY CONTROL

A. General Testing
   1. Refer to Section 27 17 00 – Structured Cabling System Testing for complete testing specifications.

END OF SECTION 27 1500

SECTION 27 1700

TESTING, IDENTIFICATION AND ADMINSTRATION OF STRUCTURED CABLING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This Section (27 1700) includes the minimum requirements for the test certification, identification, and administration of horizontal balanced twisted pair cabling and optical fiber cabling.

B. The Contractor provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

C. In order to conform to the overall project event schedule, the cabling Contractor shall survey the work areas and coordinate cabling testing with other applicable trades.

D. In addition to the tests detailed in this document, the Contractor shall notify the Owner or the Owner's representative of any additional tests deemed necessary to guarantee a fully functional system. The Contractor shall carry out and record any additional measurement results at no additional charge.

1.02 SCOPE

A. This Section includes the minimum requirements for:
   1. Identification, including labels and labeling
   2. Administration, including:
      a. Test results documentation
      b. As-built drawings
   3. The testing of copper cabling, including:
      a. Test instruments
      b. Test procedures
   4. The testing of fiber optic cabling, including:
      a. Test instruments
      b. Test procedures

B. Testing shall be carried out in accordance with this document. The Contractor shall:
   1. Test all installed balanced twisted pair cabling permanent links to the applicable performance level.
   2. Test the attenuation and polarity of the installed optical fiber cable plant with an Optical Loss Test Set (OLTS)
   3. Test the installed condition of the optical fiber cabling system and its components with an Optical Time Domain Reflectometer (OTDR)
   4. Verify the condition of the fiber end faces

C. The Contractor shall document all tests including:
   1. OLTS dual wavelength attenuation measurements
   2. OTDR traces with event tables and OTDR maps
   3. Optical length measurements and pictures of the connector end faces

1.03 REFERENCES

A. Requirements, Codes, and Standards
   1. All testing procedures and field test instruments shall comply with the applicable requirements of the following standards including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) released at the time of bid:
   2. ANSI Z136.2, ANS For Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources

3. ANSI/EIA/TIA 455 50B, Light Launch Conditions For Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements
4. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR
5. ANSI/TIA/EIA 455 60A, Measurement of Fiber or Cable Length Using an OTDR
6. ANSI/TIA/EIA 455 61A, Measurement of Fiber or Cable Attenuation Using an OTDR
7. ANSI/TIA/EIA 526 7, Optical Power Loss Measurements of Installed Single-mode Fiber Cable Plant
8. ANSI/TIA 526 14 B, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 edition 2, Fiber-Optic Communications Subsystem Test Procedure- Part 4-1: Installed cable plant- Multimode attenuation measurement
9. TIA-TSB-4979 Practical Considerations for Implementation of Multimode Launch Conditions in the Field
10. ANSI/TIA-1152, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
11. ANSI/TIA-568-0. D, Generic Telecommunications Cabling for Customer Premises.
12. ANSI/TIA-568-1. D, Commercial Building Telecommunications Cabling Standard
13. ANSI/TIA 568 C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
14. ANSI/TIA 568 C.3, Optical Fiber Cabling Components Standard
15. ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.

B. Applicability of Codes, Rules, and Regulations
1. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached.
2. If the Contractor notes items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's representative in writing.
3. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

C. Balanced Twisted Pair Testing
1. Trained technicians, who have successfully attended an appropriate training program and have obtained a certificate as proof thereof, shall execute the tests. Acceptable certificates are ones that have been issued by any of the following organizations or an equivalent organization:
2. The manufacturer of the connectors and/or the cable
3. The manufacturer of the test equipment used for the field certification
4. Training organizations such as Building Industry Consulting Service International (BICSI), the Association of Cabling Professionals™ (ACP), the Cabling Business Institute (CBI)

D. Optical Fiber Testing
1. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
2. The manufacturer of the connectors and/or the cable
3. The manufacturer of the test equipment used for the field certification
4. Training organizations such as Building Industry Consulting Service International (BICSI), the Association of Cabling Professionals™ (ACP), the Cabling Business Institute (CBI)

E. Owner’s Participation
1. The Owner or the Owner’s representative shall be invited to witness and/or review field testing.
2. Five business days before testing commences, the Owner or the Owner’s representative shall be notified of the start date of the testing phase.

3. The Owner or the Owner's representative shall:
    a. Select a random sample of five percent of the installed links
    b. Test these randomly-selected links
    c. Store the results in accordance with Part 3 of this document
4. The Contractor shall compare the results obtained by the Owner to the data provided by the installation Contractor. If more than two percent of the pass/fail determinations in the sample results differ from the data provided by the installation Contractor, the Contractor, under the supervision of the Owner's representative, shall repeat one hundred percent of the testing at no cost to the Owner.

1.04 SUBMITTALS

A. The Contractor shall submit the following:

B. The manufacturer's catalog sheets and specifications for the test equipment

C. A schedule (list) of all links and channels to be tested

D. Sample test reports

E. The test equipment serial number

F. A graphic diagram documenting the test procedure, including all connectors, the light source (as applicable,) the origin, and the destination of each cable tested.

1.05 TEST RESULTS

A. Balanced Twisted Pair Links
1. Category 5E and Category 6 Balanced Twisted Pair
2. Unless otherwise specified by the Owner or the Owners representative, each Category 5E and Category 6 balanced twisted pair cabling link shall be tested for:
    a. Wire Map
    b. Length
    c. Propagation Delay
    d. Delay Skew
    e. DC Loop Resistance
    f. DC Resistance Unbalance within a pair
    g. DC Resistance Unbalance between pairs
    h. Insertion Loss
    i. Near-End Crosstalk (NEXT)
    j. Power Sum Near-End Crosstalk (PS NEXT)
    k. Attenuation to Crosstalk Ratio Near-End (ACR-N)
    l. Power Sum Attenuation to Crosstalk Ratio Near-End (PS ACR-N)
    m. Attenuation to Crosstalk Ratio Far-End (ACR-F)
    n. Power Sum Attenuation to Crosstalk Ratio Far-End (PS ACR-F)
    o. Return Loss
    p. Transverse Conversion Loss (TCL)
    q. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
3. Category 6A Balanced Twisted Pair
4. Unless otherwise specified by the Owner or the Owners representative, each Category 6A link shall be tested for all of the parameters listed above for Category 5E and Category 6 as well as the following additional parameters:
    a. Power Sum Alien Near-End Crosstalk (PS ANEXT)
    b. Average Power Sum Alien Near-End Crosstalk (Average PS ANEXT)
    c. Power Sum Alien Attenuation to Crosstalk Ratio Far-End (PS AACR-F)
    d. Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End (Average PS AACR-F)
5. When a Balanced Twisted Pair Permanent Link Fails
6. All installed balanced twisted pair cabling permanent links shall be field-tested and shall pass the test requirements and analysis described in Part 3.

a. Any permanent link that fails these requirements shall be diagnosed and corrected.
b. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected permanent link meets performance requirements.
c. The final and passing result of the tests for all permanent links shall be provided in the test results documentation, in accordance with Part 3.

B. Optical Fiber Links
1. Test Limits
2. Unless otherwise specified by the Owner or the Owners representative, each optical fiber cabling link shall comply with the following test limits:
a. Optical loss testing
b. Multi-mode and single-mode links
c. Link attenuation calculated by the following formulas, as specified in ANSI/TIA-568-C.0:
Link Attenuation (dB)=Cable_Attn (dB)+Connector_Attn (dB)+Splice_Attn (dB)
Cable_Attn (dB) = Attenuation_Coefficient (dB/km)*Length (Km)
Connector_Attn(dB)=number_of_connector_pairs*connector loss (dB)
Maximum allowable connector loss=0.75 dB
Splice_Attn (dB)=number_of_splices*splice_loss (dB)
Maximum allowable splice_loss = 0.3 dB
d. The values for the Attenuation_Coefficient (dB/km) are listed in the table below.
e. Where application limits are more stringent, those shall apply.

type of optical fiber	*wavelength (nm)*	*attenuation coefficient (dB/km)*	*wavelength (nm)*	*attenuation coefficient (dB/km)*
Multi-mode 62.5/125 µm	850	3.5	1300	1.5
Multi-mode 50/125 µm	850	3.5	1300	1.5
Single-mode (Inside plant)	1310	1.0	1550	1.0
Single-mode (Outside plant)	1310	0.5	1550	0.5

3. OTDR Testing
a. Reflective events (connections) shall not exceed the following limits. Where application limits are more stringent, those shall apply.
b. 0.75 dB in optical loss when bi-directionally averaged
c. -35 dB reflectance for multi-mode connections
d. -40 dB reflectance for UPC single-mode connections
e. -55 dB reflectance for APC single-mode connections
f. Non-reflective events (splices) shall not exceed 0.3 db
4. Magnified End Face Inspection
a. Fiber connections shall be visually inspected for compliance with IEC 61300-3-35 Edition 1.0 for end face quality.
b. Scratched, pitted or dirty connectors shall be diagnosed and corrected.
5. When an Optical Fiber Link or Channel Fails
6. All installed optical fiber cabling links and channels shall be field-tested and pass the test requirements and analysis as described in Part 3.
a. Any link or channel that fails these requirements shall be diagnosed and corrected.
b. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements.

c. The final and passing result of the tests for all links and channels shall be provided in the test results documentation, in accordance with Part 3.

C. Acceptance of Test Results
1. Once the project is fully completed and tested in accordance with the Contract Documents and to the satisfaction of the Owner, the Owner's acceptance of the test results shall be given in writing to the Engineer.

1.06 PROJECT CONDITIONS

A. Project Environmental Requirements
1. Seismic Safety
a. Observe mechanical and electrical support means for all installed equipment as required by all applicable local building codes for this installation's earthquake risk hazard zone and as recommended by Telcordia Specification GR-63.
b. All equipment racks should to be anchored with suitable anchors that meet safety standards.
c. Overhead devices should be mounted with appropriate safety attachments as required.
d. Where cabinets and racks are secured directly to the building, this should be done in accordance with guidance provided by the Authority Having Jurisdiction (AHJ) or a structural engineer.
e. Equipment and fixtures should have shock and vibration isolation.
2. Fiber Optic Cable Safety
a. The following warnings shall be posted on the job site:
b. WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED OR LASER SOURCE OR INTO THE END OF A CABLE FIBER CONNECTED TO ONE OF THESE SOURCES.
c. CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE VISIBLE, YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR WARNING LABELS ON SOURCE DEVICES.
d. Observe all warning signs on equipment and all written safety precautions in the equipment instruction and technical manuals.
e. Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin.
3. Hazardous Materials Prohibition
a. The Contractor shall make sure that all materials used in the project are asbestos-free, unless specifically authorized in writing by the Owner.

B. Existing Conditions
1. Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer in writing of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.
2. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and upon approval, proceed with the necessary changes without additional cost to the Owner.

C. Record Drawings
1. Keep a complete set of all telecommunications drawings in the job site office for reference of the actual installation of work under this Section.
2. Use this set of drawings for no other purpose.

3. Where any material, equipment, or system components are installed differently than what is shown on the Drawings, indicate the differences clearly and neatly using ink or indelible pencil.
4. Upon completion of the project, submit the record set of Drawings.

1.07 USE OF THE SITE

A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.

B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.

C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on how and when to work in these areas.

D. Multiple times each day, each installation contractor shall remove all trash and debris from the site.

E. Before leaving the room each day:
1. The Contractor shall replace all ceiling tiles that they have removed.
2. The Contractor shall place all furniture and equipment that they have moved back into its original location.
3. The Contractor shall return any equipment that they have disconnected to working order.
4. The Contractor's Job Foreman shall inspect all work locations to make sure that the rooms are clean and that all of the tasks described above have been done.
5. It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.

1.08 CONTINUITY OF SERVICES

A. Take no action that will interfere with, or interrupt, existing building services unless previous arrangements have been made with the Owner's representative. Arrange all work to minimize shutdown time.

B. The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the contractor shall give three (3) days advance notice.

C. Should building services be inadvertently interrupted:
1. The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services.
2. The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner.

PART 2 PRODUCTS

2.01 BALANCED TWISTED-PAIR CABLE TESTERS

A. The field test instrument shall be manufactured by Fluke Networks.

B. The field test instrument shall have been calibrated within the last twelve months.

C. There shall be independent verification that the field test instrument meets the following accuracy requirements:
1. For Category 5E, Level IIe accuracy in accordance with ANSI/TIA-1152
2. For Category 6, Level III accuracy in accordance with ANSI/TIA-1152
3. For Category 6A, Level IIIe accuracy in accordance with ANSI/TIA-1152

D. Permanent Link Adapters
1. The RJ45 plug must meet the requirements for NEXT, FEXT, and Return Loss in accordance with ANSI/TIA-568-C.2 Annex C.
2. Twisted pair Category 5e, 6, 6A, 7, or 7A cords are not permitted, as their performance degrades with use and can cause false Return Loss failures.

E. Results Storage

F. The field test instrument shall be capable of storing more than 10,000 results for all measurements found within this section.

G. Measurement Capabilities for Category 5E and Category 6 Links

H. On Category 5E and Category 6 links, the field test instrument shall be capable of testing the following parameters:
   1. Wire Map
   2. Length
   3. Propagation Delay
   4. Delay Skew
   5. DC Loop Resistance
   6. DC Resistance Unbalance within a pair
   7. DC Resistance Unbalance between pairs
   8. Insertion Loss
   9. Near-End Crosstalk (NEXT)
   10. Power Sum Near-End Crosstalk (PS NEXT)
   11. Attenuation to Crosstalk Ratio Near-End (ACR-N)
   12. Power Sum Attenuation to Crosstalk Ratio Near-End (PS ACR-N)
   13. Attenuation to Crosstalk Ratio Far-End (ACR-F)
   14. Power Sum Attenuation to Crosstalk Ratio Far-End (PS ACR-F)
   15. Return Loss
   16. Transverse Conversion Loss (TCL)
   17. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
   18. Time Domain Reflectometer
   19. Time Domain Xtalk Analyzer

I. Measurement Capabilities for Category 6A

J. On Category 6A links, the field test instrument shall be capable of testing all of the parameters listed above for Category 5E and Category 6 links and all of the following parameters:
   1. Power Sum Alien Near-End Crosstalk (PS ANEXT)
   2. Average Power Sum Alien Near-End Crosstalk (Average PS ANEXT)
   3. Power Sum Alien Attenuation to Crosstalk Ratio Far-End (PS AACR-F)
   4. Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End (Average PS AACR-F)

K. PC Software

L. The field test instrument's PC software shall:
   1. Be Windows® based
   2. Show when 3 dB and 4 dB rules are applied
   3. Have re-certification capability where results have "(RC)" added to the end of the Cable IDs
   4. Have a built-in PDF export capability, as no additional third party software is permitted
   5. Have built-in statistical analysis

2.02 OPTICAL FIBER CABLE TESTERS

A. The field test instrument shall have been calibrated within the period recommended by the manufacturer, and a copy of the calibration certificate shall be made available.

B. Optical Loss Test Set (OLTS)
   1. Multi-Mode Optical Fiber Light Source
   2. The multi-mode optical fiber light source shall:
      a. Provide dual LED light sources with central wavelengths of 850 nm (±30 nm) and 1300 nm (±20 nm). VCSEL sources are not permitted per ANSI/TIA-526-14-B.
      b. Have output power of at least –20 dBm
      c. Meet the Encircled Flux launch requirements of ANSI/TIA-526-14-B

d. Have test reference cords that demonstrate an insertion loss of 0.15 dB when mated against each other
e. Be manufactured by Fluke Networks

3. Single-Mode Optical Fiber Light Source
   a. The single-mode optical fiber light source shall:
   b. Provide dual laser light sources with central wavelengths of 1310 nm (±20 nm) and 1550 nm (±20 nm).
   c. Have output power of at least –10 dBm
   d. Have test reference cords that demonstrate an insertion loss of 0.25 dB when mated against each other
   e. Be manufactured by Fluke Networks
4. Power Meter
5. The power meter shall:
   a. Provide test capability at wavelengths of 850 nm, 1300 nm, 1310 nm, and 1550 nm
   b. Have power measurement uncertainty of ±0.25 dB
   c. Store reference power measurements
   d. Save at least 10,000 results to internal memory
   e. Have a USB PC interface
   f. Be manufactured by Fluke Networks
6. Optional Length Measurement
   a. An OLTS capable of measuring the optical length of the fiber using time-of-flight techniques is preferable.
   b. For MPO/MTP trunk cables, length shall be calculated using cable jacket length markings.

C. Optical Time Domain Reflectometer (OTDR)
1. The OTDR shall:
   a. Have a color LCD display with backlight
   b. Have rechargeable Li-Ion battery for 8 hours of normal operation
   c. With battery and module, weigh no more than 4.5 pounds and have a volume of no more than 200 in2
   d. Have internal non-volatile memory with capacity for storing at least 2,000 OTDR bi-directionally-tested fiber links
   e. Have a USB port to transfer data to a PC or thumb drive/memory stick
   f. Be manufactured by Fluke Networks
2. The multi-mode OTDR shall:
   a. Provide test capability at wavelengths of 850 nm (±10 nm) and 1300 nm (+35 nm / -15 nm)
   b. Have event dead zones that do not exceed 0.7 m at 850 nm and 1300 nm
   c. Have attenuation dead zones that do not exceed 2.5 m at 850 nm and 4.5 m at 1300 nm
   d. Have distance range of at least 9,000 m
   e. Have a dynamic range of at least 28 dB for 850 nm and 30 dB at 1300 nm
   f. Allow bi-directional testing without moving the OTDR to the far end
3. The single-mode OTDR shall:
   a. Provide test capability at wavelengths of 1310 nm (±25 nm) and 1550 nm (±30 nm)
   b. Have event dead zones that do not exceed 0.6 m at 1310 nm and 1550 nm
   c. Have attenuation dead zones that do not exceed 3.7 m at 1310 nm and 1550 nm
   d. Have distance range of at least 80 km at 1310 nm and 130 km at 1550 nm
   e. Have a dynamic range of at least 32 dB for 1310 nm and 30 dB at 1550 nm
   f. Allow bi-directional testing without moving the OTDR to the far end

D. Integrated OLTS, OTDR, and Fiber Microscope
1. Test equipment that combines an OLTS, an OTDR, and a fiber microscope into one instrument may be used.

2. Any such system shall be manufactured by Fluke Networks.

2.03 ADMINISTRATION

A. Administration documentation shall include the test results of each permanent link.

B. Upon completion of the test of each link, the test result information for that link shall be recorded in the memory of the field test instrument.

C. The test result records saved in the field test instrument shall be transferred into a Windows®-based database utility that allows for the maintenance, inspection, and archiving of these test records.

PART 3 EXECUTION

3.01 GENERAL

A. Prior to field-testing, all outlets, cables, patch panels, and associated components shall be fully assembled and labeled. Any testing performed on incomplete systems shall be redone after the systems are fully assembled and labeled.

B. Upon completion of the work, a Registered Communications Distribution Designer (RCDD) shall submit as-built Drawings to the Owner or Owner's representative.

C. The Contractor shall input the cabling data into the cable management software.

3.02 SYSTEM ADMINISTRATION

A. Test Results Documentation

1. At the end of each working day, upload the copper cable permanent link test results, except for alien crosstalk testing, to the associated PC software for inspection by the Owner or the Owner's representative.
2. Test results uploaded shall allow for the maintenance, inspection, and archiving of the test records.
3. Prior to the Owner accepting the project:
   a. Store the database of the complete project, including, if applicable, fiber links, in the format native to the software.
   b. Deliver the database to the Owner on CD, DVD, or thumb-drive.
   c. To allow the Owner to inspect and print the test reports, include a working and fully-licensed copy of the software.
4. Circuit IDs reported by the test instrument should match the specified label ID. (See "LABELS" below)
5. Provide the detailed test results documentation data, in an electronic database, for each tested optical fiber and include the following information:
   a. The identification of the customer site as specified by the end-user
   b. The name of the test limit selected to execute the stored test results
   c. The name of the personnel performing the test
   d. The date and time that the test results were saved in the memory of the tester
   e. The manufacturer, model, and serial number of the field test instrument
   f. The version of the test software and the version of the test limit database held in the test instrument
   g. The fiber identification number
   h. The length of each optical fiber
   i. The index of refraction used for length calculation when using a length-capable OLTS
   j. The backscatter coefficient of the fiber under test when using an OTDR
   k. The OLTS attenuation link and channel measurements at the appropriate wavelengths and the margin (the difference between the measured attenuation and the test limit value)
   l. The OTDR link and channel traces, event tables at the appropriate wavelengths, and a map of the link tested
   m. The length of each optical fiber, as calculated by the OTDR

n. The overall pass/fail evaluation of the link-under-test for OLTS and OTDR measurements
o. A picture or image of each fiber end-face
p. A pass/fail status of the end-face using IEC 61300-3-35 Edition 1.0

6. Testing of Category 5E and Category 6 Permanent Links
7. For each Category 5E and Category 6 balance twisted-pair permanent link, provide the detailed test results documentation data in the associated PC software including:
   a. The overall pass/fail evaluation of the link-under-test
   b. The date and time the test results were saved in the memory of the tester
   c. The identification of the customer site, as specified by the Owner
   d. The name of the test limit selected to execute the stored test results
   e. The name of the personnel performing the test
   f. The version of the test firmware and the version of the test limit database held in the test instrument
   g. The manufacturer, model, and serial number of the field test instrument
   h. The adapters used
   i. The factory calibration date
   j. A aire map
   k. Propagation delay values for all four pairs
   l. Delay skew values for all four pairs
   m. DC resistance values for all four pairs
   n. DC resistance unbalance within a pair values for all four pairs
   o. DC resistance unbalance between pairs values for all four pairs
   p. Insertion loss worst case values for all four pairs
   q. NEXT worst-case margin and worst-case values in both directions
   r. PS NEXT worst-case margin and worst-case values in both directions
   s. ACR-N worst-case margin and worst-case values in both directions
   t. PS ACR-N worst-case margin and worst-case values in both directions
   u. ACR-F worst-case margin and worst-case values in both directions
   v. PS ACR-F worst-case margin and worst-case values in both directions
   w. Return loss worst-case margin and worst-case values in both directions
   x. TCL worst-case margin and worst-case values in both directions
   y. ELTCTL worst-case margin and worst-case values in both directions
   z. Time domain crosstalk data, if the link is marginal or fails
   aa. Time domain reflectometer data, if the link is marginal or fails
8. Testing of Category 6A Permanent Links
9. For each Category 6A balance twisted-pair permanent link, provide all of the same detailed test results documentation data required for Category 5E and Category 6 permanent links and also the detailed test results documentation data for alien crosstalk testing, in AxTalk Analyzer, including:
   a. PS ANEXT worst-case margin for all four pairs
   b. Average PS ANEXT worst-case margin
   c. PS AACR-F worst-case margin for all four pairs
   d. Average PS AACR-F worst-case margin

B. Submit test reports within seven (7) business days of completion of testing.

3.03 FIELD QUALITY CONTROL

A. General
1. The Owner reserves the right to be present during any or all of the testing.
2. All cabling not tested in strict accordance with these specifications shall be re-tested at no additional cost to the Owner.
3. 100% of the installed cabling must be tested. All tests must meet the acceptance criteria defined in the media specific sections of this document.

4. Prior to each day's testing, fully charge all test equipment and bring an appropriate alternate power source to the job site.
5. Throughout the testing, have a competent supervisor and supporting technical personnel, acceptable to the Owner, available on site. Changing the supervisor during the testing shall not be acceptable without prior written approval from the Owner.
6. Upon completion of the testing, it shall be the responsibility of the Contractor to perform the necessary adjustments and other controls to ensure proper system operation. The system shall be physically inspected by the Owner to assure that all equipment is installed in a neat and workmanlike manner as called for by the contract documents.
7. Verify the performance parameters of the individual systems, following established professional procedures, in addition to those specified herein. Document all acceptance testing, calibration, and correction procedures described herein, taking care to include the following information:
    a. The date on which each procedure was performed
    b. The reason that the procedure was performed
    c. The type of and a description of the procedure
    d. The parameters measured and their values, including, as applicable, the values measured prior to calibration or correction
    e. The parameters associated with calibration or corrective networks, components, or devices
    f. The names of the personnel conducting the procedure
    g. The equipment used to conduct the procedure

B. General Specifications for Testing Balanced Twisted Pair Cable
1. Use field test instruments that have the latest firmware installed.
2. Upon completion of each test, record the permanent link test results, including the individual frequency measurements from the tester, in the test instrument for subsequent uploading to the associated test equipment software in which the administrative documentation (reports) may be generated.
3. Perform permanent link testing on each cabling segment, connector to connector. Sampling is not acceptable.
4. Perform alien crosstalk testing on all Category 6A links using a sampling plan. For populations of up to 500,000 links, use an Acceptance Quality Level (AQL) of 0.4%, normal inspection, general inspection level I, as defined in ISO 2859-1. The following table lists the sample sizes to be used.

total number of links (N)	***sample size (No. of links to test)***
3 – 33	3 or 0.1 x N (whichever is greatest)
34 – 3,200	33
3,201 – 35,000	126
35,001 – 150,000	201
150,001 – 500,000	315

5. Choose an equal combination of short, medium, and long disturbed (victim) links for alien crosstalk testing.
6. Permanent link adapters made from twisted pair Category 5e, Category 6, or Category 6A cords are not permitted.
7. The installer shall build a reference Category 6A link. All components shall be anchored so that it is not possible to disturb them. Each day, the technician is to conduct a Category 6A permanent link test to ensure that there is no degradation of the tester or its permanent Llink adapters.

3.04 TESTING CATEGORY 5E LINKS

A. Frequency Resolution

B. The frequency resolution for all measurements shall be:
   1. 1 – 31.25 MHz: 150 kHz
   2. 31.25 – 100 MHz: 250 kHz

C. Wire Map Measurement

D. The length of each balanced twisted pair shall be recorded.

E. Propagation Delay

F. Record the propagation delay measurement at 10 MHz, per ANSI/TIA-1152. Per ANSI/TIA-568-C.2 Section 6.3.18, the propagation delay of each balanced twisted pair shall not exceed 498 ns.

G. Delay Skew

H. Record the delay skew measurement of each balanced twisted pair. Per ANSI/TIA-568-C.2 Section 6.3.19, the delay skew measurement Is not to exceed 44 ns.

I. DC Resistance

J. For all four pairs:
   1. Record DC resistance
   2. Record DC resistance unbalance

K. Insertion Loss
   1. Report the worst case for all four pairs in one direction only.
   2. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
   3. Insertion loss is not to exceed the limits for Category 5e permanent links specified in ANSI/TIA-568-C.2 Section 6.3.7.

L. Near-End Crosstalk (NEXT)
   1. Measure NEXT in both directions for all 12 possible pair-to-pair combinations.
   2. Report both worst case and worst margins.
   3. NEXT is not to exceed the limits for Category 5e permanent links specified in ANSI/TIA-568-C.2 Section 6.3.8.
   4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
   5. Store the time domain Xtalk data for any marginal or failing NEXT results.

M. Power Sum Near-End Crosstalk (PS NEXT)
   1. Measure PS NEXT in both directions for all 8 possible pair-to-pair combinations.
   2. Report both worst case and worst margins.
   3. PS NEXT is not to exceed the limits for Category 5e permanent links specified in ANSI/TIA-568-C.2 Section 6.3.9.
   4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
   5. Store the time domain Xtalk data for any marginal or failing PS NEXT results.

N. Attenuation Crosstalk Ratio Near-End (ACR-N)
   1. Calculate ACR-N in both directions.
   2. Record ACR-N for all 12 possible combinations.

O. Power Sum Attenuation Crosstalk Ratio Near-End (PS ACR-N)
   1. Calculate PS ACR-N in both directions.
   2. Record PS ACR-N for all 8 possible combinations.

P. Attenuation Crosstalk Ratio Far-End (ACR-F)
   1. Measure ACR-F in both directions.
   2. Report both worst case and worst margins.

3. ACR-F is not to exceed the limits for Category 5e permanent links specified in ANSI/TIA-568-C.2 Section 6.3.11.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

Q. Power Sum Attenuation Crosstalk Ratio Far-End (PS ACR-F)
1. Measure PS ACR-F in both directions.
2. Report both worst case and worst margins.
3. PS ACR-F is not to exceed the limits for Category 5e permanent links specified in ANSI/TIA-568-C.2 Section 6.3.13.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

R. Return Loss
1. Measure return loss in both directions.
2. Report both worst case and worst margins.
3. Ignore return loss at all frequencies where the insertion loss is less than 3 dB for that pair.
4. Return loss is not to exceed the limits for Category 5e permanent links specified in ANSI/TIA-568-C.2 Section 6.3.6.
5. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
6. Store the Time Domain Reflectometer data for any marginal or failing return loss results.

S. Transverse Conversion Loss (TCL)
1. Measure TCL in both directions.
2. Record TCL for all 8 possible combinations.

T. Equal Level Transverse Conversion ELTCTL Transfer Loss (ELTCTL)
1. Measure ELTCTL in both directions.
2. Record ELTCTL for all 8 possible combinations.

3.05 TESTING CATEGORY 6 LINKS

A. Frequency Resolution

B. The frequency resolution for all measurements shall be:
1. 1 – 31.25 MHz: 150 kHz
2. 31.25 – 100 MHz: 250 kHz
3. 100 – 250 MHz: 500 kHz

C. Wire Map Measurement

D. The length of each balanced twisted pair shall be recorded.

E. Propagation Delay
1. Make the propagation delay measurement, per ANSI/TIA-1152, at 10 MHz.
2. Record the propagation delay of each balanced twisted pair.
3. Propagation delay shall not exceed 498 ns per ANSI/TIA-568-C.2 Section 6.3.18
4. Record the delay skew measurement for each balanced twisted pair.
5. Per ANSI/TIA-568-C.2 Section 6.3.19, propagation delay is not to exceed 44 ns.
6. Record DC resistance for all four pairs.
7. Record DC resistance unbalance for all four pairs.

F. Insertion Loss
1. Report the worst case for all four pairs in one direction only.
2. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
3. Insertion loss is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.7.

G. Near-End Crosstalk (NEXT)

1. Measure NEXT in both directions for all 12 possible pair-to-pair combinations.
2. Report both worst case and worst margins.
3. NEXT is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.8.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
5. Store the time domain Xtalk data for any marginal or failing NEXT results.

H. Power Sum Near-End Crosstalk (PS NEXT)
1. Measure PS NEXT in both directions for all 8 possible pair combinations.
2. Report both worst case and worst margins.
3. PS NEXT is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.9.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
5. Store the time domain Xtalk data for any marginal or failing PS NEXT results.

I. Attenuation Crosstalk Ratio Near-End (ACR-N)
1. Calculate ACR-N in both directions.
2. Record ACR-N for all 12 possible combinations.

J. Power Sum Attenuation Crosstalk Ratio Near-End (PS ACR-N)
1. Calculate PS ACR-N in both directions.
2. Record PS ACR-N for all 8 possible combinations.

K. Attenuation Crosstalk Ratio Far-End (ACR-F)
1. Measure ACR-F in both directions for all 24 possible pair-to-pair combinations.
2. Report both worst case and worst margins.
3. ACR-F is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.11.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

L. Return Loss
1. Measure return loss in both directions for all 8 possible pair combinations.
2. Report worst case and worst margins.
3. Ignore return loss at all frequencies where the insertion loss is less than 3 dB for that pair.
4. Return loss is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.6.
5. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
6. Store the time domain reflectometer data for any marginal or failing return loss results.

M. Transverse Conversion Loss (TCL)
1. Measure TCL in both directions.
2. TCL for a permanent link is not specified in ANSI/TIA-1152, but record it for all 8 possible combinations.

N. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
1. Measure ELTCTL in both directions.
2. Record ELTCTL for all 8 possible combinations.

3.06 TESTING CATEGORY 6A LINKS

A. Frequency Resolution

B. The frequency resolution for all measurements shall be:
1. 1 – 31.25 MHz: 150 kHz
2. 31.25 – 100 MHz: 250 kHz
3. 100 – 250 MHz: 500 kHz

4. 250 – 500 MHz: 1000 kHz

C. Wire Map Measurement

D. Record the length of each balanced twisted pair.

E. Propagation Delay
   1. Measure the propagation delay, per ANSI/TIA-1152, at 10 MHz.
   2. Record the propagation delay of each balanced twisted pair.
   3. Per ANSI/TIA-568-C.2 Section 6.3.18, the propagation delay shall not exceed 498 ns.

F. Delay Skew

G. Record the delay skew measurement for each balanced twisted pair.

H. DC Loop Resistance
   1. Report the DC loop resistance for all four pairs.
   2. Per ANSI/TIA-568-C.2 Section 6.3, DC loop resistance is not to exceed 21 Ω for all four pairs.

I. DC Resistance Unbalance within a Pair
   1. Report DC resistance unbalance within a pair for all four pairs.
   2. Per ANSI/TIA-568-C.2 Section 6.2.2, DC resistance unbalance within a pair is not to exceed 200 mΩ or 3%, whichever is the greatest.

J. DC Resistance Unbalance between Pairs
   1. Shall be Reported DC resistance unbalance between pairs for the following pairs:

1,2-3,6	1,2-7,8	3,6-7,8
1,2-4,5	3,6-4,5	4,5-7,8

   2. DC resistance unbalance between pairs is not to exceed 200 mΩ or 7.5%, whichever is the greatest.

K. Insertion Loss
   1. Report both worst case and worst margins, in one direction, for all four pairs.
   2. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
   3. Insertion loss is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.7.

L. Near-End Crosstalk (NEXT)
   1. Report both worst case and worst margins in both directions for all pair combinations.
   2. NEXT is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.8.
   3. Mark reported margins found to be within the accuracy of the field tester an asterisk (*).
   4. Store the time domain Xtalk data for any marginal or failing NEXT results.

M. Power Sum Near-End Crosstalk (PS NEXT)
   1. Report both worst case and worst margins in both directions for all four pairs.
   2. PS NEXT is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.9.
   3. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
   4. Store the time domain Xtalk data for any marginal or failing PS NEXT results.

N. Attenuation Crosstalk Ratio Near-End (ACR-N)
   1. Report both worst case and worst margins in both directions for all pair combinations.
   2. Record ACR-N for all twelve possible combinations.

O. Power Sum Attenuation Crosstalk Ratio Near-End (PS ACR-N)
   1. Report both worst case and worst margins in both directions for all four pairs.
   2. Record PS ACR-N for all eight possible combinations.

P. Attenuation Crosstalk Ratio Far-End (ACR-F)
   1. Report both worst case and worst margins in both directions for all 12 pair combinations.

2. ACR-F is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.11.
3. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

Q. Power Sum Attenuation to Crosstalk Ratio Far-End (PS ACR-F)
1. Report both worst case and worst margins in both directions for all four pairs.
2. PS ACR-F is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.13.
3. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

R. Return Loss
1. Report both worst case and worst margins in both directions for all four pairs.
2. Ignore return loss at all frequencies where the insertion loss is less than 3 dB for that pair.
3. Return loss is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.6.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
5. Store the time domain reflectometer data for any marginal or failing return loss results.

S. Transverse Conversion Loss (TCL)
1. Report both worst case and worst margins in both directions for all four pairs.
2. TCL is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.2.14.

T. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
1. Report both worst case and worst margins in both directions for all four pairs.
2. ELTCTL is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.2.16.

U. Power Sum Alien Near-End Crosstalk (PS ANEXT)
1. The disturbed (victim) link shall have disturber links to the left and right of it and, if such links are present, above and below it.
2. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links.
3. If the link is patch-panel-to-patch-panel, then measure PS ANEXT in both directions. If the link is patch-panel-to-telecommunications-outlet, then measure PS ANEXT from the patch panel end only.
4. PS ANEXT is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.21.

V. Power Sum Alien Near-End Crosstalk (Average PS ANEXT)
1. Calculate average PS ANEXT by averaging the individual PS ANEXT loss values, in dB, for all four pairs in the disturbed (victim) link.
2. PS ANEXT is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.22.

W. Power Sum Alien Attenuation to Crosstalk Ratio Far-End (PS AACR-F)
1. PS AACR-F shall be the calculated power sum from all external pairs into the disturbed (victim) pair.
2. The disturbed (victim) link shall have disturber links to the left and right of it and, if such links are present, above and below it.
3. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links. I the link is patch-panel-to patch-panel, then measure PS AACR-F in both directions. If the link is patch-panel-to-telecommunications-outlet, then measure PS AACR-F from the patch panel end only.

4. PS AACR-F is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.25

X. Power Sum Alien Attenuation to Crosstalk Ratio Far-End (Average PS AACR-F)
1. Calculate Average PS AACR-F by averaging the individual PS AACR-F values, in dB, for all four pairs in the disturbed (victim) link.
2. The disturbed (victim) link shall have disturber links to the left and right of it and, if such links are present, above and below it.
3. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links.
4. If the link is patch-panel-to-patch-panel, measure Average PS AACR-F in both directions. If the link is patch-panel-to-telecommunications-outlet, then measure Average PS AACR-from the patch panel end only.
5. Average PS AACR-F is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA-568-C.2 Section 6.3.26.

3.07 TESTING OPTICAL FIBER CABLE

A. General
1. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with in accordance with the safety precautions specified in ANSI Z136.2.
2. Prior to field-testing, fully assemble and label all outlets, cables, patch panels, and associated components. Any testing performed on incomplete systems shall be redone after the systems are fully assembled and labeled.
3. Use field test instruments that have the latest software and firmware installed.
4. Upon completion of each test, record the link and channel test results from the OLTS and OTDR in the test instrument for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.
5. Inspect fiber end faces using a video scope with a field of view of no less than 425 µm x 320 µm.
6. Record the end face images in the memory of the test instrument for subsequent uploading to a PC and reporting.
7. Perform testing on each cabling segment, connector to connector. Sampling is not acceptable.
8. Test the cabling using high-quality test reference cords that:
   a. Are of the same core size as the cabling under test
   b. Are terminated with reference grade connectors that have a loss of no more than 0.1 dB for multi-mode and 0.2 dB for single-mode
   c. For OLTS testing, are between 2 m and 5 m long
   d. For multi-mode OTDR testing, have launch and tail fibers that are at least 100 m (328 feet) long
   e. For single-mode testing, have launch and tail fibers of lengths appropriate for the link under test, as indicated in the following table

maximum length of link (km)		***typical pulse width (ns)***	***minimum launch and tail cord length (m)***
1310 nm	***1550 nm only***		
0 to 35	0 to 50	= 1,000	130
35 to 45	50 to 65	3,000	400
45 to 50	65 to 75	10,000	1,000
= 50	= 75	20,000	2400

B. Optical Loss Testing for Horizontal and Backbone Links
1. Test multi-mode links in both directions at 850 nm and 1300 nm in accordance with ANSI/TIA-526-14-B, one-cord reference method, with an Encircled Flux compliant launch.

2. Single-mode backbone links shall be tested in both directions at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1 (the one-cord reference method).

C. OTDR Testing
   1. Test fiber links at the following wavelengths for anomalies and to ensure uniformity of cable attenuation, connector insertion loss, and reflectance:
      a. For multi-mode: 850 m and 1300 nm
      b. For single-mode: 1310 nm and 1550 nm
   2. Test each fiber link and channel in both directions.
   3. For the measurement in the opposite direction, leave the launch and tail fibers in place. Failing to do so will result in an increase in measurement uncertainty.
   4. Using a loop back fiber at the far end with a tail fiber at the near end on the adjacent fiber is permitted for bi-directional testing, as long as the OTDR can split the trace automatically into two traces for the two fibers under test.
   5. Install a launch cable between the OTDR and the first link connection.
   6. Install a tail cable after the last link connection.

D. Magnified End-Face Inspection
   1. Inspect fibers using a video scope with a minimum field of view of 425 µm by 320 µm per IEC 61300-3-35 Edition 1.0.
   2. Use the following test limits:
      a. For multi-mode connectors, Table 6 of IEC 61300-3-35 Edition 1.0
      b. For single-mode field polished connectors, Table 5 of IEC 61300-3-35 Edition 1.0
      c. For single-mode factory polished connectors, Table 3 of IEC 61300-3-35 Edition 1.0
      d. For Angled Physical Contact (APC) connectors, Table 4 of IEC 61300-3-35 Edition 1.0
   3. Length Measurement
      a. Record the length of each fiber.
      b. It is preferable that the optical length be measured using an OLTS or OTDR.
   4. Polarity Testing
      a. Test paired duplex fibers in multi-fiber cables to verify that polarity is in accordance with Clause E.5.3 of ANSI/TIA-568-C.0.

E. Verify the polarity of the paired duplex fibers using an OLTS.

F. Manufacturer's Field Service

G. At the start of the installation, periodically as the Work progresses, and after completion, furnish:
   1. The services of the manufacturer's technical representative at the job site, as needed, to advise on every phase of the Work
   2. Full-time attendance at least during the first three work days and at least once every week thereafter
   3. Technical assistance to the Installer as required

END OF SECTION 27 1700

SECTION 32 84 00
IRRIGATION

PART 1 GENERAL

1.01 SUMMARY:

A. Scope of Work: Provide all labor, materials, transportation and services necessary to furnish and install irrigation systems as shown on the Drawings and described herein.
B. Related Requirements: Review the General Contract Conditions and Division One, General Requirements, which contain information and requirements that apply to this Section.
C. Work Included: Provide irrigation system, complete, as shown and as specified.
D. Related Sections:
    1. Section 328400 Landscaping
    2. Section 015639 Tree Protection

1.02 QUALITY ASSURANCES:

A. Applicable Standards: Comply with the current applicable provisions of the following, with applicable codes and regulations of the locality and as specified.
    "UPC" - Uniform Plumbing Code published by the Association of Western Plumbing Officials
    "ASTM" - American Society for Testing and Materials
    "AWWA" - American Water Works Association
    "NSF" - National Sanitation Foundation
    ”A.S.S.E.” and the USC Foundation for Cross Connection Control.
B. Permits and Fees: The Contractor shall obtain and pay for any and all permits and all inspections as required.
C. Manufacturer's Directions: Manufacturer's directions and detail drawings shall be followed in all cases where the manufacturers articles, equipment, materials or processes specified for use in this contract furnish such directions covering points not shown in the Drawings and Specifications.
D. Ordinances and Regulations: All local, municipal and state laws, and 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 or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality or higher standard than is required by the above rules and regulations, the provisions of these Specifications and Drawings shall take precedence.
E. Explanation of Drawings:
    1. Due to the scale of 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.
    2. The term “Landscape Architect” as used herein shall refer to the Owner's authorized representative.
    3. All work called for on the Drawings by notes or details shall be furnished and installed in compliance to the manufacturers instructions whether or not specifically mentioned in the Specifications.
    4. 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 Owner's authorized representative. In the event this notification is not performed, the irrigation contractor shall assume full responsibility for any revision necessary.

1.03 SUBMITTALS:

A. Material List:

1. The Contractor shall furnish the articles, equipment, materials or processes specified by name in the Drawings and Specifications. No substitution will be allowed without prior written approval by the Landscape Architect.
2. Complete material list shall be submitted prior to performing any work. Material list shall include the manufacturer, model number and description of all materials and equipment to be used. The following is a guide to proper submittal format:

Item	Description	Manufacturer	Model No.
a.	Backflow preventer	FloCo	XXXX

3. Irrigation submittal must be specific and complete. All items must be listed and should include solvent/primer, wire, wire connectors, valve boxes, etc. No copies of manufacturer's literature (catalog cuts) are required as submittal information, unless requested.
4. The Contractor may submit substitutions for equipment and materials listed on the irrigation drawings by following procedures as outlined in Section 1.06 of the Irrigation Specifications.
5. Equipment or materials installed or furnished without prior approval of the Landscape Architect may be rejected and the Contractor required to remove such materials from the site at his own expense.
6. Approval of any item, alternate or substitute indicates only that the product or products apparently meet the requirements of the Drawings and Specifications on the basis of the information or samples submitted.
7. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.

B. Record Drawings:

1. The Contractor shall provide and keep up to date a complete record set of job site prints which shall be corrected daily and show every change from the original Drawings and Specifications and the exact, in place locations, sizes, and kinds of equipment. Prints for this purpose may be obtained from the Landscape Architect. This set of Drawings shall be kept on the site and shall be used only as a record set.
2. These Drawings shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed. The Contractor shall make neat and legible annotations thereon daily as the work proceeds, showing the work as actually installed. These Drawings shall be available at all times for inspection and shall be kept in a location known to the Landscape Architect.
3. The Contractor shall dimension from two permanent points of reference, building corners, sidewalk or road intersections, etc., the location of the following items:
    a) P.O.C. Connection to existing water lines
    b) P.O.C. Connection to existing electrical power
    c) Control valves
    d) Gate valves
    e) Quick coupling valves
    f) Routing of sprinkler pressure lines. (dimension maximum 100 feet along routing)
    g) Routing of control wiring(dimension maximum 100 feet along routing)
    h) All drip flush valves and air/vac relief
    i) Other related equipment as directed by the Landscape Architect
4. Before the date of the final inspection, the Contractor shall deliver the record prints to the Landscape Architect. All work shall be neat, in ink and subject to the approval of the Landscape Architect. The Landscape Architect will transfer the Contractor's

record information onto the digital files and will return the record drawings and provide the Contractor with a reduced print for the Contractor's use in preparing controller chart(s).

C. Controller Charts:
   1. The charts shall be a reduced Xerox bond print of the digital record drawing and the contractor shall use different colors to indicate the zones of coverage for each controller station.
   2. When completed the Contractor shall sealed the charts between the two pieces of plastic, each piece being a minimum of 10 mils in thickness.
   3. Provide two controller charts for each controller, one for the controller enclosure and one for the Owner.
   4. These charts shall be completed by the Contractor and approved by the Landscape Architect prior to final inspection of the irrigation system.

D. Operation and Maintenance Manuals:
   1. Prepare and deliver to the Landscape Architect within ten calendar days prior to completion of construction, two hard cover, three ring binders containing the following information:
      a. Index sheet stating Contractor's address and telephone number, list of equipment with name and addresses of local manufacturer's representatives.
      b. Guarantee statement.
      c. Catalog and parts sheets on every material and equipment installed under this contract.
      d. Complete operating and maintenance instruction on all major equipment. This shall include maintenance information published by the manufacturer.

      In addition to the above mentioned maintenance manuals, provide the Owner's maintenance personnel with instructions for major equipment and show evidence in writing to the Landscape Architect at the conclusion of the project that this service has been rendered.

E. Equipment to be Furnished:
   1. Supply as part of this contract the following tools:
      a) Two valve keys for operation of remote control valves
      b) Two 48 inch valve keys for operation of gate valves
      c) Two keys for each automatic controller and enclosure
      d) One key for every (3) quick coupler installed
      e) Extra remote control valves. Supply one valve for each size used
      f) Extra sprinkler heads in the amount equal to 1% of the total used on the project (extra 1 unit per 100 installed)
   2. The above mentioned equipment shall be turned over to the Owner at the conclusion of the project. Before final inspection can occur, evidence that the Owner has received material must be shown to the Landscape Architect.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING OF PVC PIPE AND FITTINGS:

A. The Contractor is cautioned to exercise care in handling, loading, unloading and storing of PVC pipe and fittings.
B. Store PVC pipe and fittings under cover until used. Do not leave pipe and fittings in open trenches, exposed to sunlight for extended periods.
C. All PVC pipe shall be transported in a vehicle which allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point.
D. Any section of pipe that has been dented or damaged will be discarded and, if installed, shall be replaced with new piping.

1.05 SEQUENCING AND SCHEDULING:

A. Install landscape headers, sidewalks, and mowing strips before installation of sprinkler system, except that sleeves and mainlines under paving shall be in place before paving construction.
B. Specimen trees (48 inch box and larger) shall be installed after staking but before the installation of the irrigation system.
C. Obtain permission in writing from the Owner at least 24 hours before shutting off existing in-use water lines. The Contractor shall receive instructions from the Owner as to the exact length of time of each shut-off.

1.06 SUBSTITUTIONS:

A. If the irrigation contractor wishes to substitute any equipment or materials for that which is listed on the irrigation Drawings and Specifications, they may request to do so by providing the following information to the Owner's authorized representative for review:
    1. Provide a statement indicating the reason for making the substitution. Use a separate sheet of paper for each item to be substituted.
    2. Provide descriptive catalog literature, performance charts and flow charts for each item to be substituted.
    3. Provide the amount of cost difference if the substituted item is approved.
B. The Owner's authorized representative shall have the sole authority and responsibility of accepting or rejecting any substituted item as an approved equal to those equipment and materials listed on the irrigation Drawings and Specifications.

1.07 GUARANTEE:

A. The guarantee for the sprinkler irrigation system shall be made in accordance with the attached form. The general conditions and supplementary conditions of these Specifications shall be filed with the Owner or his representative prior to acceptance of the irrigation system.
B. A copy of the guarantee form shall be included in the Operations and Maintenance Manual.
C. The guarantee form shall be retyped onto the Contractor's letterhead and contain the following information:

GUARANTEE FOR IRRIGATION SYSTEM:

We hereby guarantee that the 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 expected. We agree to repair or replace all defects in material or workmanship which may develop during the period of one year from date of acceptance and also to repair or replace all damages resulting from the repair of such defects at no additional cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice. In the event of our failure to make such repairs or replacements within a reasonable time after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT:_____

LOCATION: _____

CONTRACTOR/COMPANY: _____LICENSE NO:_____

ADDRESS:_____

PHONE:_____

DATE OF FINAL ACCEPTANCE:_____

SIGNED: _____DATE: _____

PART 2 - PRODUCT

2.01 MATERIALS:

A. General: Use only new materials of brands and types noted on Drawings, specified herein or approved equals.

B. The design of the irrigation system is based on the manufacturers and products indicated. Substitutions will be permitted only with the Landscape Architects approval. Where such substitution will change the coverage or flow rates of the sprinkler heads, or velocity and friction loss in pipe, the request for substitution shall include layout plans showing revised sprinkler head locations. Such revised layout plan shall provide coverage and watering rates equivalent to those indicated.

C. PVC Pressure Mainline Pipe:

D. Sizes: Pipe sizes indicated are nominal inside diameter unless otherwise noted.

1. Pressure mainline piping for sizes 1-1/2 inches and smaller shall be PVC Schedule 40 with solvent-welded joints. Pipe shall be made from NSF approved Type I, Grade I PVC compound conforming to ASTM Resin Specification D1784 and product design specification ASTM 1785. All pipe must meet requirements as set forth in Federal Specification PS-21-70 (solvent-weld pipe).
2. Pressure mainline piping for sizes 2 inches and larger, shall be PVC Class 315 (S.D.R. 13.5) with solvent-weld joints. Pipe shall be made from an NSF approved Type I, Grade I, PVC compound conforming to ASTM resin specification D1784 and product design specification ASTM 2241. All pipe must meet requirements as set forth in Federal Specification PS-22-70, with an appropriate standard dimension (S.D.R.) (solvent- weld pipe).
3. All PVC pipe must bear the following markings:
    a) Manufacturer's name
    b) Nominal pipe size
    c) Schedule or class
    d) Pressure rating in PSI
    e) NSF (National Sanitation Foundation) approval
    f) Date of extrusion

E. PVC Non-Pressure Lateral Line Piping: Pipe sizes indicated are nominal inside diameter unless otherwise noted.

1. Non-pressure buried lateral line piping of all sizes (3/4” minimum) shall be PVC Schedule 40 (S.D.R. 21) with solvent-weld joints.
2. Pipe shall be made from NSF approved, Type I, Grade I PVC compound conforming to ASTM Resin Specification D1784. All pipe must meet requirements set forth in Federal Specification PS-22-70 with an appropriate standard dimension ratio.
3. Except as noted in paragraph 1 and 2 of Section 2.1.C, all requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure mainline pipe and fittings as set forth in Section 2.1.B of these Specifications.

F. PVC Solvent-Weld Fittings and Connections:

1. For pressure lines 3” and smaller upstream of remote control valves, hose bibs and quick couplers. ASTM D 2467, Type 1, Grade 1, Schedule 80, impact molded fittings, manufactured from virgin compounds as specified for piping, tapered socket or molded thread type, suitable for either solvent weld or screwed connections. Machine threaded fittings and plastic saddle and flange fittings are not acceptable.
2. For non-pressure lines downstream of remote control valves. ASTM D 2464 or D 2466, Type 1, Grade 1, Schedule 40, high impact molded fittings, manufactured from virgin compounds as specified for piping, tapered socket or molded thread type, suitable for either solvent weld or screwed connections. Machine threaded fittings and plastic saddle and flange fittings are not acceptable.
3. All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable I.P.S. schedule and NSF seal of approval

G. PVC Welding Solvent and Primer:
    1. Solvent cements shall comply with ASTM D2564. Socket joints shall be made per recommended procedures for joining PVC plastic pipe and fittings with PVC solvent cement and primer by the pipe and fitting manufacturer and procedures outlined in the appendix of ASTM D2564.
    2. All Classes PVC:
        a)2 " and under - Weld-On 2721 or 2711 PVC Solvent and P-70 Primer
        b)3” and over - Weld-On 2711 PVC Solvent and P-70 Primer
    3. Schedule 40 PVC:
        a) 2 " and under -Weld-On 2721 or 2711 PVC Solvent and P-70 Primer
        b) 3” and over - Weld-On 2711 PVC Solvent and P-70 Primer
    4. Schedule 80 PVC
        a)All sizes - Weld-On 2711 PVC Solvent and P-70 Primer.
H. PVC to PVC or PVC to Metal Threaded Connections:
    1. Thread lubricant shall be teflon ribbon-type, suitable for threaded installations as per PVC pipe and fitting manufacturer's recommendations.
I. PVC Schedule 80 Risers and Nipples:
    1. Polyvinyl Chloride Schedule 80 Risers and Nipples. Type 1, Grade 1, Schedule 80, high impact molded, manufactured from virgin compounds as specified for piping. Threaded ends shall be molded threads only. Machined threads are not acceptable. PVC Schedule 80 nipples and risers shall conform to ASTM D-2464.
J. Brass Pipe and Fittings:
    1. Where indicated on the Drawings, IPS, 125 pound, 85% red brass screwed pipe conforming to ASTM B 43-91.
    2. Fittings shall be IPS, 125 pound, 85% red brass, threaded, conforming to ANSI B16.15-85.
K. Control Wiring:
    1. Connections between the automatic controller and the electric control valves shall be made with direct burial, color coded, twisted pair IDWIRE by Hunter Industries. No substitutions will be permitted for the wire specified.
    2. Connections between the decoders and the valve solenoids shall be made with standard pair 18 AWG, twisted to improve surge resistance.
L. Control Wiring Water Proof Connectors:
    1. Field splices between the automatic controller and electrical control valves shall not be allowed without prior approval of the Landscape Architect
    2. All splices of control wiring shall be made with Spears Dri-Splice, Rainbird Snap-Tite wire connector or approved equal.
M. Pull Boxes:
    1. Pull boxes for control wire shall be Carson No. 1419-12 with dimensions of 10-3/4" x 16" x 12", or approved equal. Boxes shall be green in color. The cover shall be secured with a stainless steel bolt-down mechanism. Pull box extensions shall be by the same manufacturer as pull box.
    2. The cover shall be heat branded with the letters IRR-COM two inches high. Pull Boxes shall not exceed 500’ in distance apart and be located at every street or driveway crossing.
N. Backflow Prevention Device: Per Civil
O. Backflow Prevention Device Enclosure: Per Civil
P. Remote Control Valve and Remote Control Valve / Pressure Regulator Assembly:
    1. Remote control valve shall be normally closed electrically actuated diaphragm type. Valve body shall be constructed of brass and stainless steel. Valve shall include manual flow adjustment handle and internal manual bleed cock for manual operation. Valve shall be as specified in irrigation legend.
    2. The remote control valve shall include a tag to identify the Controller / Station number. Controller / Station ID tags shall be maxi size, recycled/ reclaimed identification tags as manufactured by Christy’s Irrigation or approved equal.

Q. Gate Valves:
    1. Gate valves shall be class 150 bronze gate valves with screw-in bonnet, non-rising stem and solid wedge disc. Gate valves shall have threaded ends and shall be equipped with a bronze hand wheel.
    2. Gate valves shall be Hammond 606-64 as manufactured by Hammond or approved equal.
R. Quick Coupling Valves:
    1. Quick coupling valves shall have a brass two-piece body designed for water systems with a working pressure of up to 150 psi.
    2. Quick coupling valves shall be operable with a quick coupler key.
    3. Quick coupling valve with key shall be as specified in the irrigation legend.
S. Control Valve Boxes:
    1. Use 10 inch x 10-1/4 inch round box for all gate valves. Carson Industries No. 910-12 with bolt down cover, green color, or approved equal. Valve box extensions shall be by the same manufacturer as the valve box.
    2. Use 9-1/2 inch x 16 inch x 12 inch rectangular box for each remote control valve/pressure regulator assembly and filter assembly. Box shall be Carson Industries No. 1419-12 with bolt down cover, green color, or approved equal.
T. Sprinkler and Bubbler Heads:
    1. Rotating Stream Type:
        a. The sprinkler shall be of the viscous fluid brake rotary type and be an adjustable arc, adjustable radius, matched precipitation rate, multi-stream, multi-trajectory rotating stream sprinkler.
        b. The sprinkler shall produce and maintain a matched precipitation rate no greater than 0.6” per hour throughout the arc adjustment range and radius adjustment range, (up to 25% of radius reduction), when spaced at 50% of wetted diameter.
        c. The part circle sprinkler shall have an infinitely adjustable arc from 45° to 105°, 90° to 210° or between 210° to 270° depending on the model selected. The full circle sprinkler shall irrigate a full 360°. The 45° to 105° model shall not require coverage from adjacent sprinklers closer than 3’ from the head.
        d. Full or part circle sprinklers shall be capable of up to 25% radius reduction using a stainless steel radius adjustment screw. The radius reduction screw shall have a slip clutch mechanism to prevent internal damage if turned past the minimum or maximum radius settings. The radius reduction screw shall reduce the pressure and flow upstream of the adjustable orifice thereby maintaining stream integrity.
        e. Part circle sprinklers shall have arc adjustment capabilities using a stainless steel ring. The adjustment ring shall be effective only while the sprinkler is popped up and shall be ineffective while the sprinkler is popped down. When turned past the minimum or maximum arc limits the adjustment mechanism shall have a ratcheting action to prevent internal damage. This same ratcheting action shall allow the orientation of the left edge of the variable arc when installed on a fixed riser or in a popup body. This is independent of and in addition to any ratchet that may exist in a popup body.
        f. The sprinkler itself shall pop-up at approximately 15 psi of water pressure. Upon cessation of water pressure, the sprinkler itself shall retract. When installed in a pop-up body the sprinkler itself shall pop-up after the body stem is almost fully extended. Upon decreasing pressure the sprinkler itself shall pop-down before the pop-down of the body stem is complete. The sprinklers adjustable orifice shall be manufactured from polyurethane and acetyl plastic materials for durability. The sprinkler shall be fitted with a detachable filter.

g. Sprinkler Assembly shall be manufactured in Corner, Side Strip, Left Strip, and Right Strip configurations capable of being installed in fixed 40 PSI pop-up bodies having a 5/8-27 UNS male threaded stem, at all common popup heights. Sprinkler Assembly shall also be able to be attached to a 1/2 FIPT x 5/8-27 UNS male threaded adapter for use on fixed pipe risers. Sprinkler Assembly shall also be able to be attached to a 1/2 FIPT x 5/8-28 UNS female threaded adapter for use on fixed pipe risers.

U. Irrigation Controller:
   1. Shall be a web based application providing programming control of Rain Master Eagle controllers via the internet. The system shall utilize wireless 2-way communications (providing confirmation of delivery) for all transmissions.
      The communications shall be provided by third party wireless carrier infrastructure located throughout the United States.
      The website shall allow programming changes to be performed either at the controller or at the website. The website shall automatically detect field changes at the controller when they occur and notify the user. The website shall generate email notifications and SMS messages to any email or SMS capable device (e.g. cell phones) in order to inform the end user of field maintenance and manual intervention activities. The website shall automatically disseminate daily weather information on a per controller basis in order to facilitate water savings.
   2. The irrigation controller shall be the iCentral web-based controller as manufactured by RainMaster, per the irrigation schedule.

V. Master Valve
   a. The master valve shall be normally open, solid brass (ASTM B584, B271, B505) self-cleaning, automatic electric globe valve with manual flow control stem. Valve shall operate with pressures to 200 psi and shall be slow closing with a one-piece molded diaphragm incorporated with an integral o-ring seal reinforced with 600 pound test fabric. Equip with an internal self-flushing filter and self-cleaning metering rod for dirty water. Plunger and solenoid stem shall be electroless nickel plated for corrosion protection. The 24 vac 3 way solenoid coil shall be guaranteed for the life of the valve. Valve shall be as manufactured by Superior Controls or approved equal.

W. Flow sensor
   1. The flow sensor shall be an in-line type with a non-magnetic, spinning impeller (paddle wheel) as the only moving part, constructed of the following components:
      a. The electronics housing shall be glass-filled PPS.
      b. The impeller shall be glass-filled nylon or Tefzel® with a UHMWPE or Tefzel sleeve bearing.
      c. The shaft material shall be tungsten carbide.
      d. The electronics housing shall have two ethylene-propylene O-Rings and shall be easily removed from the meter body.
      e. The sensor electronics will be potted in an epoxy compound designed for prolonged immersion.
      f. Electrical connections shall be 2 single conductor 18 AWG leads 48 inches long. Insulation shall be direct burial “UF” type colored red for the positive lead and black for the negative lead.
      g. The sensor shall operate in line pressures up to 100 psi and liquid temperatures up to 140° F, and operate in flows of 1 foot per second to 20 feet per second with linearity of ± 1% and repeatability of ± 1%.
      h. The meter body shall be fabricated from Schedule 80 PVC Tees, available in 1 ½”, 2 ”, 3, and 4” with socket end connections.
      i. Equal to: Badger Model IR-220P.

X. Rain Gauge Equipment
   a. The site shall be provided with one rain sensor connected to the Irrigation Central Control System. Type used is Irritrol model RS-1000 (compatible with controller).

Conduit for roof mounting to be per manufacturer's specifications (including U-channel wall mounting brackets), and shall meet Division 16 requirements.

Y. Drip System:
   1. Shall be a complete system of in-line emitter drip line, fittings, vacuum/air release valves, flush valves, and system operation indicators as manufactured by Toro Irrigation.
      a) DL2000 Subsurface Dripline, with Treflan root protection
      b) Air Vent Assembly—pre-assembled and ready to install for labor savings
      c) Required Inlet/Outlet Fittings
      d) Flush Assembly Fittings (8 gpm, 2 psi sealing flush valve)
      e) Installation Fittings
      f) Insert fitting tees, couplings, elbows and end clamps for a secure connection
      g) Blue Stripe polyethylene tubing crossing through sleeves
      h) Soil staples for secure tubing placement during installation

PART 3 EXECUTION

3.01 INSPECTION:

A. Site Conditions:
   1. Before start of installation of the irrigation system, examine the site, construction documents and/or as-built drawings of other trades to:
      i. Verify location of existing underground utilities valves, manholes, catch basins, and other appurtenances that will affect the layout of the sprinkler system.
      ii. Verify location of existing trees, new specimen trees, and other obstructions that will affect the layout of the sprinkler system.
      iii. Verify location of stub outs and points of connection to the water supply system.
      iv. Verify grades to determine that work may safely proceed in keeping within the specified trench depths.

B. Exercise extreme care in excavating and working near existing utilities. The contractor shall be responsible for damages to utilities which are caused by his operations or neglect. Check any existing utility drawings for existing utility locations.

3.02 PREPARATION:

A. Physical Layout:
   1. Locations indicated are diagrammatic and approximate only and shall be changed and adjusted as necessary and as directed to meet existing and built conditions and to obtain complete water coverage.
   2. Prior to installation, the Contractor shall stake out all pressure supply lines and control wire routing, control valve and sprinkler head locations. Maintain the staking of the approved layout until installation is completed.
   3. All layouts shall be approved by the Landscape Architect prior to installation.
   4. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities which are caused by their operations or neglect. Refer to civil drawings for existing utility locations.
   5. Sprinkler lines shall have a minimum clearance of 3 inches from each other and 36" from other utility lines. Do not install parallel lines directly over one another.
   6. Coordinate installation of irrigation materials, including pipe, so there shall be NO interference with utilities or other construction or difficulty in planting trees, shrubs and groundcovers.

B. Water Supply:
   1. The irrigation system shall be connected to water supply points of connection as indicated on the drawings and as approved by the owner.
   2. Connections shall be made at approximate locations as shown on the Drawings. (See also civil drawings)

3. The contractor is responsible for minor changes caused by actual site conditions.

C. Electrical Supply:
   1. Electrical power supply connection is available at an existing automatic controller and is located approximately where shown on the Drawings. The contractor shall have a licensed electrician connect the existing power supply to the new controller and shall verify the continuity of the electrical supply prior to beginning their work.

3.03 EXCAVATING AND TRENCHING:

A. General: Perform all excavations as required for installation of work, including shoring of earth banks, if necessary.

B. Trenching:
   1. Dig trenches straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow layout indicated on drawings and as noted.
   2. Trench depth shall be adequate to provide backfill cover to a depth measured from top of pipe to finished grade as follows:
      a) Provide for a minimum cover of 18 inches for all PVC pressure mainlines 2" and smaller.
      b) Provide for a minimum cover of 12 inches for all PVC non-pressure lines 11/2" and smaller.
      c) When not installed trench shared with PVC pressure mainline, provide for a minimum cover of 18 inches for all control wiring.

C. Backfilling:
   1. The trenches shall not be backfilled until all required tests are performed (see section 3.06). Trenches shall be carefully backfilled with the excavated materials approved for backfilling. Backfilled trenches in landscaped areas shall be mechanically compacted in to a dry density equal to adjacent undisturbed soil. Backfilled areas will conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.
   2. Excavated trench material used for backfill shall consist of earth, loam, sandy clay, sand or other approved materials, free from large clods of earth or stone. Approved backfill shall be a fine granular material without foreign matter, rocks, clods or stones larger than 1/2 inch in size.
   3. Where existing on-site material is not suitable as backfill, the contractor shall provide sand bedding a minimum of 2 inches under, around and 2 inches above top of pipe for PVC plastic pipe and brass piping.
   4. Flooding of trenches will be permitted only with approval of the Landscape Architect.
   5. If settlement of any backfilled area occurs and subsequent adjustments and/or repairs of pipe, valves, sprinkler heads, lawn or planting or other construction are necessary, the Contractor shall make all required adjustments and/or repairs without additional cost to the Owner.

D. Trenching and Backfilling Under Paving:
   1. Trenches located under areas where paving, asphaltic concrete or concrete will be installed shall be backfilled with sand (a layer 4 inches below the pipe and 3 inches above the pipe) and compacted in layers to 95% compaction, using manual or mechanical tamping devices. Trenches for piping shall be compacted to equal the compaction of the existing adjacent undisturbed soil and left in a firm unyielding condition. All trenches shall be left flush with the adjoining grade. The landscape irrigation contractor shall set in place; cap and pressure test all piping under paving prior to the paving work.
   2. Generally, piping under existing walks is done by jacking, boring or hydraulic driving, but where any cutting or breaking of sidewalks and/or concrete is necessary, it shall be done and replaced by the Contractor as part of the contract cost. Permission to cut or break sidewalks and/or concrete shall be obtained from the Landscape Architect. No hydraulic driving will be permitted under concrete paving. Compact all

backfill to 95% dry density and dispose of waste off site. Replacement pavement shall match existing in structure, material and appearance.

3. Provide for a minimum cover of as listed in section 3.03 B between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete paving.

E. Point of Connection (POC):
   1. Connections to Water Supply: Connect new underground piping to existing water supply line downstream of the backflow preventer shut-off valve. Provide flanges, adapters and other necessary fittings required to make the connections.

F. Installation of PVC Pipe:
   1. Pipe shall be cut using approved PVC pipe cutters only. Sawed joints will not be permitted. All field cuts shall be beveled to remove burrs and excess before fitting and solvent weld of joints.
   2. PVC Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before joints are made. Pipe ends and fittings shall be treated with MEK, or other primer recommended by the pipe manufacturer, before welding solvent is applied.
   3. Socket joints shall be made in accordance with recommended procedures for joining PVC plastic pipe and fittings with PVC solvent cement by the pipe and fitting manufacturer and procedures outlined in the Appendix of ASTM D 2564-93. Welded joints shall be given a minimum of 15 minutes to set before moving or handling. Install no assembly into a trench which has standing water.
   4. When connection is plastic to metal, PVC female adapters shall be used with short (not close) PVC SCH 80 threaded nipples if needed to complete the connection. Joints shall be made with 2 clockwise wraps of Teflon tape on male threaded fitting. Hand tightened joint plus one turn with a strap wrench.
   5. Assemble and place pipe lines having rubber ring seal joints in accordance with manufacturer's written instructions.
   6. Snake pipe from side-to-side of trench bottom to allow for expansion and contraction.
   7. No water shall be permitted in the pipe until inspections have been completed and a period of at least 24 hours has elapsed for solvent weld setting and curing.
   8. Center load pipe with approved backfill to prevent arching and slipping under pressure. Leave joints exposed for inspection during testing.
   9. At changes of direction of 45 degrees or more for pipes 2-1/2 inches and larger, construct concrete thrust blocks against undisturbed earth with sufficient bearing to resist the thrust of water

G. Brass or Galvanized Iron Pipe:
   1. Cut piping by power hacksaw, circular cutting machine using an abrasive wheel, or hand hacksaw. Do not cut brass piping with metallic wheel cutter of any description. Ream and remove rough edges or burrs so smooth and unobstructed flow is obtained.
   2. Make threaded pipe connections using Teflon tape in clockwise wraps applied to male threads only.
   3. Dielectric bushings shall be used for connections of piping of dissimilar metal materials.

H. Conduit and Sleeves:
   1. For new sleeving and conduit, provide materials and coordinate installation with other trades as required to facilitate a smooth construction sequence.
   2. Conduit: Furnish and install conduit where control wires pass under or through walls, walks and paving. Conduits to be of adequate size to accommodate retrieval for repair of wiring and shall extend 12 inches beyond edges of walls and pavement. Use conduit sweeps at all changes in direction.
   3. Sleeving: Install sleeves for all pipes passing through or under walks and paving as shown on the Drawings. Sleeving to be of adequate size to accommodate retrieval of wiring or piping for repair and shall extend 12 inches beyond edges of paving or other

construction. Curve sleeves where required by heat forming pipe. No fittings shall be used for sleeves.

I. Assemblies:
   1. Routing of irrigation lines as indicated on the Drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to avoid conflicts with other improvements and to route within planting areas in accordance with the details and plans. See planting plans for tree locations to avoid aligning irrigation under tree rootballs.
   2. Install all assemblies specified herein in accordance with respective detail drawings. In absence of detail drawings or specifications pertaining to specific items required to complete work, perform such work in accordance with Manufacturer direction, best standard practice and approval of Landscape Architect.
   3. PVC Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer. Install no assembly into a trench which has standing water.
   4. On PVC to metal connections, the Contractor shall work the metal connections first. Teflon tape or approved equal shall be used on all threaded PVC to PVC and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Use strap-type friction wrench only -- no metal jawed wrench.

J. Line Clearance: All lines shall have a minimum clearance of 6 inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.

K. Automatic Controller:
   1. Remote control valves shall be connected to existing controller in the numerical sequence shown on the Drawings.
   2. Test grounding system to verify that equipment is properly grounded.
   3. Perform continuity and resistance tests on all control wire, both existing and proposed, to insure that proper voltage will be delivered to the equipment on line.

L. Control Wire:
   1. Provide one control wire and one common ground wire to service each valve in system or per plan notes. Provide 4 foot minimum expansion loop at each valve to permit removal and maintenance of valves.
   2. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible.
   3. Install control wires at least 16 inches below finish grade and minimum of 4 inches from pipe or fittings except at terminal points.
   4. Where more than one wire pair is placed in a trench, the wiring shall be bundled and taped together at intervals of 10 feet, using two wraps of electrical tape.
   5. An expansion curl shall be provided at each major change of direction and at every remote control valve. Expansion curl (or coil) at the remote control valve shall be 3 feet long. Control wires shall be laid loosely in trench without stress or stretching of control wire conductors

M. Water Proof Wire Connectors for Control Wire:
   1. All splices shall be made according to the manufacturer's directions.

N. Pull Boxes:
   1. Pull boxes for control wire shall be installed at ends of sleeves for paving crossing in excess of 50'.

O. Remote Control Valve
   1. Install remote control valve assemblies in locations approximately where shown, with 4 inch clearance between top of flow control cross handle and box lid. Each assembly to be in a separate valve box as detailed and noted.
   2. When grouped together, allow adequate space between valves to provide at least 12 inches between valve boxes and so that all boxes can be placed in a uniform row 12" from and perpendicular to edge of planting area. (see detail drawings)

3. Valves with boxes shall be installed in non-conspicuous locations whenever practical. Locations shall be staked for approval by the Landscape Architect. Staked locations must be approved before installation.

P. Master Valve
   1. Install normally open master valve as specified in standard drawings and per manufacturer's specifications. Install prior to the flow sensor. Install with a cover of 4" minimum and 8" maximum over top of flow control stem. Fit each valve with a rectangular valve box set over 3" gravel with filter fabric.

Q. Gate Valves:
   1. Install each gate valve as detailed and noted in a separate valve box with extension as needed to provide access. See also location requirements as described for remote control valves.

R. Quick Coupling Valves:
   1. Install each quick coupler valve as detailed and noted within a separate valve box. See also location requirements as described for remote control valves.

S. Sprinkler Bubbler Heads:
   1. Install the sprinkler heads as designated and/or noted on the Drawings, Notes and Details. Sprinkler heads to be installed in this work shall be as noted in the legend and these specifications.
   2. Installation of pop-up sprinkler heads shall be made using with the bottom inlet with the exception of 12" pop-up which shall be made using the side inlet.
   3. Spacing of heads shall not exceed the maximum indicated on the drawings. Lay-out and spacing of sprinkler heads is with the intention to achieve head-to-head coverage without over-spray.
   4. Sprinkler heads and nozzles shall be adjusted to suit any particular conditions of the area. This shall be done after the system has been thoroughly tested, immediately after written notification by the Architect to do so.

T. Subsurface Drip Irrigation Installation:
   1. Excavate amended soil in all areas to be drip irrigated to design depth for drip lines, per the detailed drawings
   2. Install PVC pipe manifolds in trenches and through sleeves under paving per plan and the detailed drawings. Connect to drip valve assembly.
   3. Lay tubing on grade, cut and rough stake to spacing indicated on the detailed drawings.
   4. Connect tubing with required fittings, air/vacuum relief valves, flush valves and system indicators.

U. Flushing of System:
   1. Cap or plug all openings as soon as lines have been installed to prevent the entrance of debris or any contaminants that will obstruct pipe line or foul small orifice emitters. Leave in place until connections can be completed.
   2. After all new irrigation system valves, pipelines and risers are in place and before connection of lateral lines, the control valves shall be opened and a full head of water used to flush out the system.
   3. Sprinkler heads shall be installed only after flushing of the entire system, including lateral lines and swing joints, has been accomplished to the complete satisfaction of the Landscape Architect.
   4. Line flush valves shall be installed only after flushing of the system has been accomplished to the complete satisfaction of the Landscape Architect.

3.04 TECHNICAL SUPPORT:

A. On-site pre-construction system familiarization meeting for Contractor, Landscape Architect, and/or Irrigation Consultant and Owner to insure that all parties involved understand the system and installation techniques.

B. The contractor shall be responsible to schedule and organize on-site, pre-construction meeting. The following equipment manufacturers / suppliers shall be in attendance:

3.05 TEMPORARY REPAIRS:

A. The Owner reserves the right to make temporary repairs as necessary to keep the existing sprinkler system equipment in operating condition. The exercise of this right by the builder/developer shall not relieve the Contractor of his responsibilities under the terms of the guarantee as herein specified.

3.06 EXISTING TREES:

A. Where it is necessary to excavate adjacent to existing trees, the Contractor shall use all possible care to avoid injury to trees and tree roots. Excavation in areas where 2 inch and larger roots occur shall be done by hand. All roots two inches and larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and shall be wrapped in three layers of burlap, to prevent scarring or excessive drying. Where a ditching machine is run close to trees having roots smaller than 2 inches in diameter, the wall of the trench adjacent to the tree shall be hand trimmed, making clean cuts through. Roots 1 inch and larger in diameter shall be painted with two coats of Sarvon at full strength. Trenches adjacent to trees should be closed within 24 hours; and where this is not possible, the side of the trench adjacent to the tree shall be kept shaded with moist burlap or canvas.

3.07 FIELD QUALITY CONTROL:

A. Adjustment of the System:
   1. If it is determined that adjustments in the irrigation equipment will provide better uniformity of coverage, the Contractor shall make such adjustments prior to planting.
   2. Lowering and raising valve boxes or any other adjustments by the Contractor shall be accomplished within ten days after notification by Owner.

B. Testing of Irrigation System:
   1. The Contractor shall request the presence of the Landscape Architect in writing at least 48 hours in advance of testing.
   2. Test all pressure lines under hydrostatic pressure of 150 pounds per square inch and prove watertight
      Note: Testing of pressure mainlines shall occur prior to installation of electric control valves.
   3. All piping under paved areas or on structure shall be tested under hydrostatic pressure of 150 pounds per square inch and proved watertight.
   4. Sustain pressure in lines for not less than two hours with 5 psi maximum drop in pressure. If leaks develop, replace joints and repeat test until entire system is proven watertight.
   5. All hydrostatic tests shall be made only in the presence of the Landscape Architect or other duly authorized representative of the Owner. Center load pipe sections between fitting with backfill to prevent arching during hydrostatic testing. All fittings are to left exposed.
   6. Backfill of pipe line trenches can not be completed until pipe lines have been inspected, tested and approved by the landscape architect.
   7. Furnish necessary force pump and all other test equipment.
   8. Furnish all materials and perform all work required to correct any inadequacies of coverage.

3.08 MAINTENANCE:

A. The entire irrigation system shall be under full automatic operation prior to any shrub and groundcover planting. Trees shall be watered by hand until the irrigation system is operable.

B. Final acceptance of the planting by the landscape architect shall constitute the beginning of the guarantee period and the 60-day irrigation maintenance and plant establishment period.

3.09 CLEAN-UP:

A. Clean-up shall be made as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed or washed down and any damage sustained on the work of others shall be repaired to original condition.

3.10 FINAL INSPECTION PRIOR TO ACCEPTANCE:

A. The Contractor shall operate each system in its entirety for the Landscape Architect at time of final inspection. Any items deemed not acceptable by the inspector shall be reworked to the complete satisfaction of the Landscape Architect.

B. The Contractor shall show evidence to the Landscape Architect that the Owner has received all maintenance manuals, documentation of testing, irrigation accessories, charts, record drawings and equipment as required before final inspection can occur.

3.11 OBSERVATION SCHEDULE:

A. Contractor shall be responsible for notifying the Landscape Architect in advance for the following observations, according to the notice time indicated:
    1. Pre-job conference - 7 days
    2. Pressure supply line installation and testing, Control wire installation - 48 hours
    3. Coverage test and Final observation - 48 hours

B. When observations have been conducted by other than the Landscape Architect, show evidence of when and by whom these observations were made.

C. No observation will commence without the record drawings. In the event the Contractor calls for an observation without record drawings, without completing previously noted corrections or without preparing the system for observation, he shall be responsible for reimbursing the Landscape Architect at the hourly rate of $100.00 for the inconvenience. No further observations will be scheduled until this charge has been paid.

END OF SECTION

SECTION 32 90 00
LANDSCAPING

PART 1 GENERAL

1.01 GENERAL CONDITIONS:

A. The General Conditions, and Special Conditions are a part of this section and the Contract for this work and apply to this section as fully as if repeated herein.

1.02 SUMMARY:

A. The work includes all services, labor, materials, transportation and equipment necessary to perform the work as shown and noted on the drawings and/or specified herein.
B. All utilities (water and electricity) used during the installation of the landscapingand irrigation systems for this project shall be paid for by the Owner.
C. All plant material will be purchased by the Contractor and delivered to the site by the Contractor's supplier for off-loading and installation by the Contractor.

1.03 SUBMITTALS:

A. Contractor shall submit a complete list of soil amendments, fertilizers, and plant materials, specified with quantities and suppliers of each, a minimum of six (6) weeks prior to delivery to the site.
B. Contractor shall submit signed copies of certificates, invoices and trip slips to the Landscape Architect for verification of quantities of all materials delivered to site for incorporation into work.
C. Contractor shall submit one pint each of the following to the Landscape Architect for approval:
    1. Soil Conditioner
    2. Organic Mulch

1.04 GUARANTEES AND REPLACEMENTS:

A. All commercially grown shrubs, vines and groundcovers shall be guaranteed by the Contractor to remain healthy and vigorously growing for 90 days from date of final acceptance of project.
B. All trees that have been installed under this Contract shall be guaranteed by the Contractor to live in a healthy condition for a period of one (1) year from date of final acceptance of project.
C. All commercially grown plants found to be dead and all plants not in a vigorous condition noted within the Guarantee Period shall be replaced within (14) calendar days.

1.05 SITE OBSERVATION VISITS:

A. Site observation visits herein specified shall be made by the Landscape Architect. The Contractor shall request site observation two (2) days in advance of the time observation is required.
B. Site observation will be required for the following parts of the work:
    1. Incorporation of soil conditioner and fertilizer into the soil and upon completion of grading prior to planting.
    2. Approval of plant materials with trees and shrubs spotted in place for planting, but before planting holes are excavated.
    3. When planting, and all other indicated or specified work, except the Plant Establishment Period, has been completed. Acceptance and written approval shall establish the beginning of the Plant Establishment Period.
    4. Final site observation visit at the completion of the Plant Establishment Period. This site observation visit shall establish the beginning date for the guarantee period for plant material and irrigation.
C. Other site inspections will be made by the Landscape Architect at their discretion.

D. The Contractor or their authorized representative shall be on the site at the time of each scheduled site observation visit by the Landscape Architect.

1.06 MAINTENANCE:

A. The Contractor shall continuously maintain all involved areas of the Contract during the progress of the work and during a 90-day Plant Establishment and Maintenance Period until Final Acceptance of the work by the Landscape Architect.
B. Regular planting maintenance operations shall begin immediately after each plant is planted. Plants shall be kept in a healthy, growing condition and in a visually pleasing appearance by watering, pruning, trimming, edging, fertilizing, re-staking, pest and disease controlling, spraying, weeding, cleaning-up and any other necessary operation of maintenance. Landscape areas shall be kept free of weeds, noxious grass, and all other undesired vegetative growth and debris. All plants found to be dead or in an impaired condition shall be replaced immediately.
C. No pruning of tree limbs shall be permitted without the consent of the Landscape Architect.
D. The Contract completion date of the Plant Establishment/Maintenance Period will be extended, when in the opinion of the Landscape Architect, improper maintenance and/or possible poor or unhealthy condition of planted material is evident. The Contractor shall be responsible for additional maintenance of the work at no change in Contract price until all of the work is completed and acceptable.
E. The Contractor shall be responsible for maintaining reasonable protection of contract areas. Damaged areas shall be repaired immediately at the Contractor's expense.

1.07 GENERAL REQUIREMENTS:

A. The term "Planting Area" shall mean all areas to be planted with trees, shrubs, groundcovers, lawn and vines.
B. Actual planting shall be performed during those periods when weather and soil conditions are suitable in accordance with locally accepted horticultural practice.
C. All rock and other growth or debris accumulated within the duration of the project shall be removed from the site.
D. Prior to excavation for planting or placing of plant materials, locate all underground utility lines still in use and take proper precautions to avoid damage to such improvements. In the event of a conflict between such lines and plant locations, immediately notify the Landscape Architect who shall arrange for the re-location of one or the other. The Contractor assumes all responsibility for making any and all repairs for damages resulting from work as herein specified.
E. Grading and soil preparation work shall be performed only during the period when beneficial and optimum results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure, spreading and grading operations shall be suspended until the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.
F. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and immediately inform the Landscape Architect of any discrepancy between the drawings and/or specifications and actual conditions.
G. Quantities for plant materials are shown for convenience only, and not guaranteed. Check and verify count and supply sufficient number to fulfill intent of drawings. Certify any clarifications with the Landscape Architect.
H. Adequately stake, barricade, and protect all irrigation equipment, existing trees, manholes, utility lines, and other existing property during all phases of the soil amending planting and grading operations
I. Upon completion of all grading operations, the Contractor shall request a Soil Sampling Kit from the Landscape Architect and then shall take a composite soil sample from representative planting areas throughout the site which shall be analyzed for agronomic suitability by:

Gro-Power, Inc., 15065 Telephone Avenue, Chino, CA 91710-9614

Ph: (800) 473-1307
Analysis shall be for complete agricultural suitability of soil with individual recommendations for lawn, hydroseed & California Native plantings. The results of these tests are to be reviewed by the Landscape Architect for possible modifications to the specified soil preparation.

1.08 PLANT SELECTION:

A. Upon award of the project the Contractor shall inform the Landscape Architect of the nursery source of all plants. The Landscape Architect and the Owner will check the plants at the nursery source for approval. If the plants are rejected, the Contractor shall be responsible for locating other sources of plants. The contract price for the project shall not change due to rejected plants. The Contractor shall make all necessary financial arrangements or purchase orders to reserve the plants specifically for this project.

1.09 REJECTION AND SUBSTITUTION:

A. All plants not conforming to the requirements herein specified and on the drawings shall be considered defective and such plants, whether in place or not, shall be marked as rejected and be immediately removed from the site of the work and replaced with acceptable plant materials. The plant materials shall meet all applicable inspections required by law. All plants shall be of the species, variety, size, age, flower color and condition as specified herein and/or as indicated on the drawings. Under no condition will there be any substitution of plant species, variety, or reduced sizes for those listed on the accompanying drawings, except with the express written consent of the Landscape Architect and the Owner.

1.10 INVOICING OF PLANT MATERIALS:

A. After installation of plant amendments and prior to the pre maintenance site observation visit, the Contractor shall provide the Landscape Architect with copies of the required certifications, trip slips, and invoices for the plant materials amendments and shall compare the total area and/or the amounts specified. If the minimum amounts have not been furnished, the Landscape Architect will require at the contractors expense, the installation of additional materials to fulfill the minimum requirements specified.

PART 2 PRODUCTS

2.01 SOIL AMENDMENT AND FERTILIZER:

A. Soil conditioner shall be commercially processed bark or wood product which has been well composted, consisting of a commercial blend of organic fractions supplying gradient degrees of breakdown and conforming to the following requirements:
    1. Derived from bark of pine, white fir or redwood, or from cedar or redwood shavings.
    2. Composted a minimum of 180 days and a maximum of 1 year. pH shall be 7.0 maximum and 5.5 minimum.
    3. Salinity maximum 3.1 mmhos per centimeter at 25 degrees C. as measured by saturation extract conductivity.
    4. Impregnated with a minimum of 1% nitrogen, 0.04% phosphoric acid, 0.04% available potash, 0.02% calcium, 0.03% magnesium and 0.05% iron. Redwood particles to be 1/50" to 1/4" in size, organic matter 97% moisture content 30%.
    5. Ash content not to exceed 10%.
    6. Soil Conditioner shall be equal to #1 Soil Amendment by Organic Recycling West, (619) 661-6712.
B. Post-Plant Fertilizer Gro-Power Controlled Release 12-8-8
C. Soil Sulfur: Shall be 99% elemental sulfur, Wil-Gro Life or approved equal.
D. Soil Activator: Shall be Gro-Power Plus w/ M
E. Soil Inoculant: Shall be Gro-Life Mycorrhizal Inoculum
F. Fertilizer Tablets: Shall be GroPower 7 gram size.
G. Wetting Agent: Shall be a non-toxic, biodegradable, non-polluting equal to: Sarvon

H. Flowable Gypsum: Gypsum for all 2:1 + slope areas shall be 50% gypsum (calcium sulfate dihydrate) and 50% inert carrier equal to: Gypsum Flowable.
I. Gypsum for all non-slope areas (less than 2:1) shall be a commercially packed gypsum with the active ingredient calcium sulfate at 95% by volume.

2.02 STAKING MATERIALS:

A. Double Staking: Stakes shall be of lodge pole pine. These shall be straight shafts, shaved and cut clean and bare of branches and stubs, of uniform thickness with a minimum diameter of 2 inches, free of loose knots, splits or bends. Stakes shall be no less than ten (10) feet in length.
B. Tree ties shall be V.I.T. Cinch-Tie or approved equal.

2.03 PLANT MATERIALS:

A. Nomenclature: The scientific and common names of plants herein specified conform with the approved names given in "A Checklist of Woody Ornamental Plants of California", published by the University of California, College of Agriculture, Publication 4091 (1979). See list of plant material on drawings.
B. Container stock (1 gallon, 5 gallon, 15 gallon and boxes) shall have grown in containers for at least six months, but not over two years. No container plants that have cracked or broken balls of earth, when taken from the container, shall be planted, except upon special approval. No trees with damaged roots or broken balls shall be planted.
C. Pruning shall not be done, prior to delivery, except by written approval by the Landscape Architect.
D. Inspection of Plant Materials, required by City, County or State authorities, shall be a responsibility of the Contractor, and where necessary the Contractor shall secure permits or certifications prior to delivery of plants to site
E. Plants shall be subject to approval or rejection, at the project site at any time before or during progress of work, for size, variety, condition, latent defects and injuries. Rejected plants shall be removed from the project site immediately.
F. Substitutions will not be permitted unless proof is submitted by the Contractor that any plant specified is not obtainable. A proposal for substitution will be submitted by the Contractor to the Landscape Architect and the Owner for approval.
G. Quantities shall be furnished as needed to complete work shown on drawings.
H. The Landscape Architect reserves the right to check root condition of any species, particularly those grown from seed, and if found defective, to reject the plants represented by the defective sample.
I. Identify plant species or varieties correctly on legible, weatherproof labels attached securely to the plant material. There shall be a minimum of one labeled plant for each 25 plants in a lot.
J. Groundcover plants shall be healthy vigorous rooted cuttings grown in flats until transplanting.

2.04 MULCH:

A. Organic mulch shall be equal to “Bark Blend” by Organic Recycling West (619) 661-6712.

2.05 HERBICIDES

A. No herbicides shall be used without the express written consent of the owner.

2.06 ROOT CONTROL BARRIERS

A. Provide sheet-type root barriers wherever paving comes within 10 feet of a tree. Root barriers shall be 24” high, one piece, void of hinge-type sections and with connections made by solvent-welded couplings. Material shall be a minimum of 0.60” thick with ½” vertical ribs at 6” on center and be made of at least 50% post-consumer high-impact polystyrene with rubberizer and UV inhibitors. Equal to: ‘NDS’ Root Barrier Sheet Material SM-2420. (800) 726-1994

PART 3 EXECUTION

3.01 GENERAL

A. The quantities given below are for bidding purposes. If unsatisfactory soil conditions should be encountered over the course of the work the Contractor shall alert the Landscape Architect who will obtain a soil sample for agronomic testing.

3.02 SOIL CONDITIONING, FERTILIZING AND ROTOTILLING:

A. After planting areas have been and graded, the following rates of soil conditioning and amendment materials shall be evenly spread over all planting areas less than 2:1 in slope and shall be thoroughly scarified to an average depth of six (6) inches by rototilling a minimum of two (2) alternating passes, followed by six (6) inches of water leaching performed in three (3) applications of two (2) inches each.

1. Soil Sulfur: 30 lbs./1,000 sq.ft.
2. Soil Conditioner: 3 cu.yd./1,000 sq.ft.
3. Wetting Agent: 1 quart/1,000 sq. ft.
4. Gypsum: 50 lbs/1,000 sq. ft.
5. Soil Activator: 100 lbs/1000 sq. ft.
6. Soil Inoculant: 20 lbs/1000 sq. ft.

B. Slopes 2:1 and steeper, omit soil conditioner application and tilling and treat as follows:

1. Apply flowable gypsum at the rate of 2 quarts per 10 gallons of water per 1,000 sq. ft.
2. Apply iron sulfate at the rate of 3 pounds per 1,000 sq. ft.
3. Apply wetting agent at the rate of 2 ounces per 1,000 sq. ft.
4. Spray 15-15-15 fertilizer at the rate of 5 pounds per 1,000 sq. ft.

C. Planting backfill in tree and shrub planting areas shall be a thoroughly blended mixture of excavated soil from the planting pits and soil amendments at the following mixture:

1. Soil Conditioner 20%
2. On Site Soil 80%
3. Gypsum 3 lbs.
4. Soil Sulfur 2 lbs./cu. yd.
5. Soil Activator 15 lbs./cu. yd.
6. Soil Inoculant 3 lbs./cu. Yd.

D. The thoroughness and completeness of the rototilling and incorporation of the soil conditioners/amendments shall be acceptable to the Landscape Architect prior to commencement of planting operations.

3.03 FINISH GRADING:

A. Finish grades shall be as indicated on the landscape drawings.

B. Finish grades shall be measured as the final water compacted and settled surface grades and shall be within plus or minus 0.1 foot of the spot elevations and grade lines indicated on the drawings.

C. Finish grades shall be measured at the top surface of surface materials.

D. Molding and rounding of the grades shall be provided at all changes in slope and as directed by the Landscape Architect.

E. All undulations and irregularities in the planting surfaces resulting from tillage, rototilling and all other operations shall be leveled and floated out before planting operations are initiated.

F. The Contractor shall take every precaution to protect and avoid damage to sprinkler heads, irrigation lines, and other underground utilities during their grading and conditioning operations.

G. Final finish grades shall insure positive drainage of the site with all surface drainage away from buildings, walls, and toward roadways, swales, drains and catch basins.

H. Final grades shall be acceptable to the Landscape Architect before planting operations will be allowed to begin.

I. Planting surfaces shall be graded with no less than one (1) percent surface slope for positive drainage to catch basins and drain inlets.

3.04 PLANTING:

A. The layout of locations for plants and outlines of groundcover to be planted shall be approved on the site by the Landscape Architect, prior to their planting. All such locations shall be checked for possible interference with existing underground piping, prior to excavation of holes. If underground construction or utility lines are encountered in the excavation of planting areas, other locations for the planting may be selected by the Landscape Architect. Damage to existing utilities shall be the responsibility of the Contractor.

3.05 PLANTING TREES, SHRUBS AND VINES:

A. Planting holes shall be twice the diameter of the container size or as approved by the landscape architect, and in no case shall holes be too small to accommodate plant rootballs.

B. Excavation shall include the stripping and stacking of all acceptable soil encountered within the areas to be excavated for plant pits and planting beds. Protect all areas that are to be trucked over and upon which soil is to be temporarily stacked pending its re-use for the fillings of holes, pits and beds.

C. Excess soil, generated from the planting holes shall be spread evenly over the site by the Contractor.

D. All used containers shall be removed to the storage area or from the site by the Contractor.

E. The plants shall be planted at approved locations with the heretofore specified conditioner and soil planting backfill.

F. Water settle the planting pits to the rootball base levels prior to the placement of the plants. After setting the plants loosen any encircling roots before the remaining backfill material is hand tamped and settled around each rootball.

G. Each tree and shrub shall be placed in the center of the hole and shall be set plumb and held rigidly by the rootball in position until the planting backfill has been tamped around each root ball.

H. All plants shall be set at such a level that after settling they bear the same relationship to the surrounding finish grade as they bore to the soil in the container.

I. Planting tablets shall be placed in each tree or shrub planting hole at the following rates:

1. 15 - 7 gram tablets per 15 gallon container
2. 4 - 7 gram tablet per 6 inch of box size
3. 8 - 7 gram tablets per 5 gallon container
4. 3 - 7 gram tablet per each 1 gallon container
5. 1 - 7 gram tablet per groundcover plant

J. No plant will be accepted if the rootball is broken or cracked, either before, during or after the process of installation.

K. All plants shall be thoroughly watered into the full depth of each plant hole immediately after planting.

L. All trees, 24" box size and larger, shall be staked with two wood stakes driven into the ground on the north and south sides of the tree. The stakes shall be driven in plumb and secure outside of the tree rootball. Special care shall be taken that the driving in of the stake shall be does not damage the tree roots or rootball. Tree ties shall be fastened to each tree and stake by looping figure 8's with the inside diameter of the tie at 2 or 3 times the diameter of the tree and by nailing the back of the tie to the stake (see detailed drawings).

M. The staking shall be accomplished in such a manner as to insure the proper and healthy growth and the safety of the plants, property, and the public.

N. The Contractor shall be responsible for all surface and subsurface drainage required which may affect his guarantee of the trees, shrubs, and vines. Notify the landscape architect if detrimental subsurface drainage conditions exist.

O. Pruning after planting shall be required on all trees, shrubs and vines when necessary to provide the specified or approved standard shapes, form and/or sizes characteristic to each plant. Pruning may include thinning, topping, and/or cutting and shall be under the direction of the Landscape Architect. Cuts over 3/4 inch in diameter shall be painted with an approved tree sealant.

3.06 PLANTING GROUNDCOVERS:

A. Groundcovers shall be planted in the areas indicated on the drawings. The groundcover plants shall be rooted cuttings grown in flats, and shall remain in those flats until transplanting.

B. All groundcover plants shall be planted with moist soil around roots in staggered rows, evenly spaced at the intervals called out on the drawings.

C. The groundcover plants shall be planted sufficiently deep to cover all roots and shall be immediately sprinkled with water after planting until the entire area is soaked to the full depth of all holes.

3.07 MULCH APPLICATION:

A. In all shrub and tree areas indicated on the drawings to receive organic mulch apply 2" minimum depth of organic mulch, tapering to 1” at plants and at paving.

B. In all flatted groundcover planting areas indicated on the drawings to receive organic mulch apply 2” minimum depth of organic mulch, tapering to 1” at plants.

3.10 POST FERTILIZATION:

A. Post Fertilization for all planting areas shall occur a rate of 15 lbs. per 1,000 sq. ft. applied at the end of the Plant Establishment/Maintenance period.

3.11 CLEAN UP:

A. As project progresses, the Contractor shall maintain all areas in a neat manner and remove unsightly debris as necessary, sweeping walks weekly. After completion of project, the Contractor shall remove all debris and containers used in accomplishing work. All sidewalks, asphalt, paving and concrete areas adjacent to plantings shall be washed down by the Contractor, and any stains or discolorations shall be removed prior to final acceptance of the work.

END OF SECTION